

PROJECT MANUAL
FOR
Richland School District
Fran Rish Stadium Improvements

1330 Lee BLVD
Richland, Washington

Volume 2
DIVISION 10 – DIVISION 33



December 09, 2021



Design West Architects
830 N Columbia Center Blvd, Suite E
Kennewick, WA 99336
509-783-2244

VOLUME 2: Division 10 – Division 33

DIVISION 10 – SPECIALTIES

Section 10 11 16	Markerboards	5
Section 10 11 23	Tackboards	3
Section 10 14 00	Signage	6
Section 10 14 63	Electronic Readerboard	3
Section 10 21 13	Toilet Compartments.....	4
Section 10 26 13	Corner Guards	3
Section 10 28 00	Toilet, Bath and Health Care Accessories	4
Section 10 41 16	Emergency Key Cabinets	1
Section 10 44 00	Fire Extinguisher & Emergency Cabinets	5
Section 10 51 13	Metal Lockers and Benches	5
Section 10 75 00	Flagpoles	2

DIVISION 11– EQUIPMENT

Section 11 30 13	Residential Appliances.....	2
Section 11 68 24	Field & Track Equipment & Furnishings	6

DIVISION 12– FURNISHINGS

Section 12 21 13	Horizontal Louver Blinds	4
Section 12 63 13	Aluminum Stadium Bench Seating	3
Section 12 93 00	Site Furnishings	3

DIVISION 13– SPECIAL CONSTRUCTION

Section 13 31 30	Tensile Fabric Facade	14

DIVISION 14 through DIVISION 20 – not used

DIVISION 21– FIRE SUPPRESSION

Section 21 10 00	Fire Protection.....	11

DIVISION 22– PLUMBING

Section 22 05 13	Common Motor Requirements for Plumbing Equipment.....	3
Section 22 05 17	Sleeves and Sleeve Seals for Plumbing Piping.....	5
Section 22 05 18	Escutcheons for Plumbing Piping	2
Section 22 05 23	General-Duty Valves for Plumbing Piping	10
Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment	12
Section 22 05 53	Painting and Identification for Plumbing Piping and Equipment	5
Section 22 07 19	Plumbing Piping Insulation	21
Section 22 08 00	Plumbing Commissioning	2
Section 22 11 16	Domestic Water Piping	13
Section 22 11 19	Domestic Water Piping Specialties.....	12
Section 22 11 23	Domestic Water Pumps	4
Section 22 13 16	Sanitary Waste and Vent Piping	13
Section 22 13 19	Sanitary Waste Piping Specialties	10
Section 22 33 00	Electric, Domestic-Water Heaters.....	6
Section 22 34 00	Fuel-Fired, Domestic-Water Heaters	6
Section 22 42 13.13	Commercial Water Closets	4
Section 22 42 13.16	Commercial Urinals.....	4
Section 22 42 16.13	Commercial Lavatories	5
Section 22 47 16	Commercial Urinals.....	3

DIVISION 23– HEATING, VENTILATING & AIR CONDITIONING

Section 23 05 13	Common Motor Requirements for HVAC Equipment	3
Section 23 05 29	Hangers and Supports for HVAC Piping & Equipment	8
Section 23 05 48	Vibration Controls for HVAC	7
Section 23 05 53	Identification for HVAC Piping and Equipment	7
Section 23 05 93	Testing, Adjusting and Balancing for HVAC	15
Section 23 07 13	Duct Insulation	21
Section 23 08 00	HVAC Commissioning	6
Section 23 09 00	Controls and Instrumentation for HVAC	8
Section 23 11 23	Facility Natural-Gas Piping	10
Section 23 23 00	Refrigerant Piping	9
Section 23 31 13	Metal Ducts	7
Section 23 33 00	Air Duct Accessories	6
Section 23 34 16	Centrifugal HVAC Fans	4
Section 23 37 00	Air Outlets and Inlets	2
Section 23 37 13	Diffusers, Registers, and Grilles	3
Section 23 54 00	Furnaces	7
Section 23 72 00	Air to Air Energy Recovery Equipment	7
Section 23 81 26	Split-System Air-Conditioners	6
Section 23 81 29	Variable Refrigerant Flow HVAC Systems	19
Section 23 82 16	Air Coils	3
Section 23 82 39	Unit Heaters	4

DIVISION 24 through DIVISION 25 – not used

DIVISION 26– ELECTRICAL

Section 26 00 20	Electrical Demolition	3
Section 26 05 00	Common Work Results for Electrical	7
Section 26 05 19	Low-Voltage Electrical Power Conductors and Cables	4
Section 26 05 26	Grounding and Bonding for Electrical Systems	4
Section 26 05 29	Hangers and Supports for Electrical Systems	3
Section 26 05 33	Raceways and Boxes for Electrical Systems	7
Section 26 05 53	Identification for Electrical Systems	5
Section 26 05 73	Power System Studies	6
Section 26 08 00	Electrical Commissioning	4
Section 26 09 23	Lighting Control Devices	8
Section 26 24 16	Panelboards	5
Section 26 27 26	Wiring Devices	4
Section 26 28 13	Fuses	1
Section 26 28 16	Enclosed Switches and Circuit Breakers	4
Section 26 43 13	Surge Protection for Low-Voltage Electrical Power Circuits	2
Section 26 51 10	Interior Lighting	5
Section 26 52 19	Emergency and Exit Lighting	3
Section 26 56 00	Sports Field Lighting	5
Section 26 56 10	Exterior Lighting	3

DIVISION 27– TELECOMMUNICATIONS

Section 27 08 00	Communications Commissioning	2
Section 27 10 00	Structured Cabling	16
Section 27 13 23	Communications Optical Fiber Backbone Cabling	6
Section 27 51 00	Sound Reinforcement System	5

DIVISION 28– FIRE ALARM AND SECURITY

Section 28 05 13	Conductors and Cables for Electronic Safety and Security	8
Section 28 08 00	Electronic Safety and Security Commissioning	2

Section 28 31 13	Intrusion Security System	12
Section 28 46 21	Addressable Fire Alarm System	8

DIVISION 29 through DIVISION 30 – not used

DIVISION 31– EARTHWORK

Section 31 00 00	Earthwork	3
Section 31 11 00	Clearing and Grubbing	5
Section 31 22 16	Field & Track Subgrade Establishment	3
Section 31 23 00	Trenching, Backfill and Compacting	3
Section 31 46 22	Field & Track Imported Sands	2

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 32 12 16	Asphalt Paving	3
Section 32 12 18	Track Asphalt Paving	3
Section 32 13 13	Site Concrete Work	4
Section 32 13 73	Concrete Paving Joint Sealants	2
Section 32 18 23	Rubberized Track Surfacing	7
Section 32 18 24	Synthetic Turf Surfacing	17
Section 32 31 14	Chain Link Fencing & Accessories	4
Section 32 84 00	Landscape Irrigation	12
Section 32 84 23	Field & Track Washwater Systems	9
Section 32 85 00	Landscape Grading	3
Section 32 92 00	Turf and Grasses	6

DIVISION 33– UTILITIES

Section 33 05 16	Utility Structures	3
Section 33 08 00	Utilities Commissioning	2
Section 33 11 16	Site Water Utility Distribution Piping	4
Section 33 31 00	Sanitary Utility Sewage Piping	3
Section 33 41 00	Storm Utility Drainage Piping	3
Section 33 46 16	Field & Track Subsurface Drainage	5
Section 33 46 23	Field & Track Permeable Aggregate	7

DIVISION 10 – SPECIALTIES

Section 10 11 16	Markerboards	5
Section 10 11 23	Tackboards	3
Section 10 14 00	Signage	6
Section 10 14 63	Electronic Readerboard	3
Section 10 21 13	Toilet Compartments.....	4
Section 10 26 13	Corner Guards	3
Section 10 28 00	Toilet, Bath and Health Care Accessories	4
Section 10 41 16	Emergency Key Cabinets	1
Section 10 44 00	Fire Extinguisher & Emergency Cabinets	5
Section 10 51 13	Metal Lockers and Benches	5
Section 10 75 00	Flagpoles	2

SECTION 10 11 16 – MARKERBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Markerboards framed—fixed.
 - 2. ~~Markerboards – sliding.~~
 - 3. Accessories and support systems for visual display boards.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Division 06 Section "Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
 - 3. Division 06 Section "Interior Architectural Woodwork" for casework integration.
 - 4. Division 22 Section "Plumbing" for rough-in and coordination of sinks, service fixtures and fittings, supply and waste lines, connections and vents incorporated into casework.
 - 5. Division 23 Section "HVAC" for coordination of ductwork and vents incorporated into casework.
 - 6. Division 26 Section "Electrical" for rough-in and coordination of electrical, phone, data outlets, J-boxes, conduit, fittings and cabinet lighting and controls incorporated into casework.

1.2 DEFINITIONS

- A. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes markerboards.
- B. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of markerboards and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Show locations of special-purpose graphics for visual display surfaces.
 - 3. Include sections of typical trim members.
- C. Samples for Verification: For each type of visual display surface indicated.
 - 1. Visual Display Surface: Not less than ~~8-1/2~~ by ~~11 inches~~, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: ~~6-inch-~~ long sections of each trim profile.
 - 3. Accessories: Full-size Sample of each type of accessory.
- D. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.
- E. Qualification Data: For qualified Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- G. Operation and Maintenance Data: For visual display surfaces to include in maintenance manuals.
- H. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- C. 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: 450 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.7 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel.
 - 1. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Melamine: Thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- C. High-Pressure Plastic Laminate: NEMA LD 3.
- D. Hardboard: ANSI A135.4, tempered.
- E. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- F. Extruded Aluminum: **ASTM B 221**, Alloy 6063.
- G. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific tack wall panels and substrate application, as recommended in writing by visual display surface manufacturer, and with a VOC content of **50 g/L or less** when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch-thick porcelain-enamel face sheet with high-gloss finish. Note special music staff graphics required in some locations, reference drawings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: Claridge, Product: Series 3 fixed marker and Evolve fixed wall mounted with sliding whiteboard. Reference drawings for specific sizes for this project. Note some custom sizes may occur.
 - b. AARCO Products, Inc.; equivalent to above
 - c. ADP Lemco, Inc. ; equivalent to above
 - d. Ghent Manufacturing, Inc. ; equivalent to above
 - e. Marsh Industries, Inc.; Visual Products Group. ; equivalent to above
 - f. Platinum Visual Systems; ABC School Equipment, Inc; equivalent to above
 - g. PolyVision Corporation; a Steelcase company. ; equivalent to above
 - h. Tri-Best Visual Display Products; equivalent to above
 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
 4. Coordination with storage casework located behind sliding marker boards and support systems for visual display boards. Reference drawings for additional details.

2.3 MARKERBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
1. Factory-Applied Trim: Manufacturer's standard.
- B. Chalktray: Manufacturer's standard, continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
- C. Map Rail: Provide the following accessories:
1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
 2. End Stops: Located at each end of map rail.
 3. Map Hooks: Two map hooks for every 48 inches of map rail or fraction thereof.

2.4 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assembled visual display boards unless otherwise indicated.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect, as indicated on approved Shop Drawings.
 2. Provide manufacturer's standard vertical-joint H-trim system between abutting sections of markerboards.
 3. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

- D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 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. 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.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- C. Examine walls & partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
 - 1. Prime wall surfaces indicated to receive direct-applied, visual display tack wall panels and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - 2. Prepare surfaces to receive visual display wall coverings and test for moisture according to requirements specified in Division 09 Section "Wall Coverings."
 - 3. Prepare substrates indicated to receive visual display wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.
 - a. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
 - b. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - c. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 - d. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

- 1. Mounting Height **36 inches** above finished floor to top of chalktray.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than **16 inches** o.c. Secure both top and bottom of boards to walls.

- 1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than **24 inches** o.c.

- a. Attach chalktrays to boards with fasteners at not more than **12 inches** o.c.

3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10 11 16

SECTION 10 11 23 – TACKBOARDS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes

1. Tackable unframed wall panels, vinyl faced to match 09 72 00 color selection.
2. Coordinate installation and layout of tackable wall panels with adjacent wall mounted equipment.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 06 Section "Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
3. Division 06 Section "Interior Architectural Woodwork" for casework integration.
4. Division 10 Section "Visual Display Surfaces" for sliding marker and tackboard applications.
5. Division 22 Section "Plumbing" for rough-in and coordination of sinks, service fixtures and fittings, supply and waste lines, connections and vents incorporated into casework.
6. Division 23 Section "HVAC" for coordination of ductwork and vents incorporated into casework.
7. Division 26 Section "Electrical" for rough-in and coordination of electrical, phone, data outlets, J-boxes, conduit, fittings and cabinet lighting and controls incorporated into casework.

1.2 DEFINITIONS

- ##### A. Tackboard:
- Visual display surface that is factory fabricated into composite tackable panel form, either with or without a perimeter frame; includes tackboards.

1.3 REFERENCES

- ##### A. 2015 IBC /ASTM E 84 - Test Method for Surface-Burning Characteristics of Building Materials.
- ##### B. 2015 IBC - Test Method for Evaluating Room Fire Growth Contribution of Textile Wall Coverings.

1.4 SUBMITTALS

- ##### A. Submit product data and installation instructions under provisions of Division 1.
- ##### B. Product Data:
- For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
- ##### C. Shop Drawings:
- For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
1. Show locations of panel joints.
 2. Show locations of special-purpose graphics for visual display surfaces.
 3. Include sections of typical trim members.
- ##### D. Product Schedule:
- For visual display surfaces. Use same designations indicated on Drawings.
- ##### E. Product Test Reports:
- Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- ##### F. Operation and Maintenance Data:
- For visual display surfaces to include in maintenance manuals.
- ##### G. Warranties:
- Sample of special warranties.

1.5 QUALITY ASSURANCE

- 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: 450 or less.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate work with other finish trades.
- B. Sequence installation after all other finish work is completed in each room to receive panels.

1.8 MAINTENANCE

- A. Provide 4 additional panels (of each size used on project) as extra stock, properly wrapped and identified.
- B. Provide 25 linear feet of each color of fabric and vinyl used. Roll, wrap and identify. Scrap pieces are not acceptable.

PART 2 – PRODUCTS

2.1 MANUFACTURES

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Basis-of-Design Product: The design for each tile type is based on the product named in the finish schedule. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified

2.2 UNFRAMED TACKABLE WALL PANEL

- A. [Nelson Adams \(909\) 256-8938](#) Product: [TWP Series](#)
- B. [Lamvin \(800\) 446-6329](#) Product: [Soft-Tone Tackable Panels](#)
- C. [Platinum Visual System \(800\) 498-2990](#) Product: [Vinyl Wrapped Tackboard](#)
- D. [Inwest Manufacturing \(801\) 514-5416](#) Product: [TWS-WRP System](#)
- E. [Jasco](#)
- F. Substitutions under provisions of Division 1.
- G. Tackable Wall Panel Assembly
 - 1. Core: ½" Micore fiberboard.
 - 2. Surface: Vinyl Fabric covering with all edges wrapped
 - a. Flame Spread – Class A
 - b. 100% polyester Type II Vinyls equal to:
 - 1. [Koroseal Interior Products](#)
 - 2. [Finish material on wrapped boards shall match VWC type as shown on 090000 Finish Schedule.](#)
 - 3. Adhesive: Type recommended by panel manufacturer for application.

2.3 FABRICATION

- A. Visual Display Boards: Factory assembled visual display boards unless otherwise indicated.

- B. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

2.4 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. 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.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials and panels are dry and ready for installation.

3.2 EXECUTION

- A. Adhere panels to walls in a true and level manner. Place panels in a method to maximize contact bedding. Butt ends tight to adjacent panels.
- B. Joints for all materials shall not exceed 1/16" space, including all miter joints or the material shall be replaced.
- C. Install tackboards level, plumb, true, and straight.

3.3 CLEANING

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

3.4 PROTECTION OF FINISHED WORK

- A. Protect work under provisions of Division 1.

END OF SECTION 10 11 23

SECTION 10 14 00 – SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building Dedication Plaque
 - 2. Panel signs and sign assemblies
 - a. Room identification signs
 - b. Code required signage
 - c. Directional signs
 - 3. Exterior and Interior Metal Cast Letters
 - 4. Metal Die Cut Characters
- B. Related Sections include the following:
 - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
 - 3. Division 26 Sections for electrical service and connections for illuminated signs.
 - 4. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.

1.2 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements including tactile characters and Braille, and layout for each sign.
- C. Samples: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Aluminum: For each form, finish, and color, on **6-inch-** long sections of extrusions and squares of sheet at least **4 by 4 inches**.
 - 2. Acrylic Sheet: **8 by 10 inches** for each color required.
 - 3. Polycarbonate Sheet: **8 by 10 inches** for each color required.
 - 4. Panel Signs: Not less than **12 inches** square including border.
 - 5. Accessories: Manufacturer's full-size unit.
- D. Sign Schedule: Use same designations indicated on Drawings.
- E. Qualification Data: For fabricator.
- F. Maintenance Data: For signs to include in maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer>.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
 - E. Mock-up
 - 1. Submit one (1) sample of each Sign Types and one (1) of all mounting systems to be used. The Owner reserves the right to disassemble any item and to subject items to any test necessary to determine its strength or character without being responsible for any damage to the item caused thereby. Samples will not be returned
 - 2. Provide full scale mock-up of each sign type, including all anchorage and fastening methods for review and approval of the Architect. Coordinate full installation to include lighting, and related trades. When accepted the mock-up may remain in place, and will serve as the standard of acceptable quality for all other installations
- 1.5 PROJECT CONDITIONS
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
 - B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- 1.6 COORDINATION
- A. Coordinate placement of anchorage devices with templates for installing signs.
- 1.7 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
 - B. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft-lbf/in. per ASTM D 256, Method A.
 - 2. Tensile Strength: 9000 lbf/sq. in. per ASTM D 638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D 790.
 - 4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D 648.
 - 5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
 - C. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.
- 2.2 BUILDING DEDICATION PLAQUE
- A. Basis-of-Design Product: Subject to compliance with requirements, provide signage system to match existing interior signs as manufactured by:
 - 1. Plaque: Best Sign Systems - Similar to #228577. Signage script and dimensions as shown on drawings. Satin brass finish, engraved lettering filled in black. Lettering style: as indicated in drawing.
 - 2. Substitutions under provisions of Division 01.

2.3 PANEL SIGNS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide signage system as manufactured by:
1. Standard Room Identification Signs: Best; sign type as defined in sub-section "B" below:
 2. Subject to substitution request as provided in Division 01, alternate suppliers for these sign types are:
 - a. Advance Corporation; Braille-Tac Division.
 - b. Allen Industries Architectural Signage
 - c. APCO Graphics, Inc.
 - d. ASI-Modulex, Inc.
 - e. Best Sign Systems Inc.
 - f. Fossil Industries, Inc.
 - g. Gemini Incorporated.
 - h. Grimco, Inc.
 - i. InPro Corporation
 - j. Mohawk Sign Systems.
 - k. Nelson-Harkins Industries.
 - l. Seton Identification Products.
 - m. Signature Signs, Incorporated.
- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus **1/16 inch** measured diagonally from corner to corner, complying with the following requirements:
1. Acrylic Sheet: 1/32 **inch** thick.
 2. Laminated Sheet: 1/8 inch phenolic with contrasting color laminated to acrylic face as selected by Architect from manufacturer's full range.
 3. Provide complete with 1" tall by width of the sign clear "window" insert slot (where noted)
 4. Edge Condition: Square cut.
 5. Corner Condition: Rounded to radius indicated.
 6. Mounting: Unframed.
 - a. Wall mounted with exposed stainless steel anchors
 - b. Manufacturer's standard anchors for substrates encountered.
 - c. Reference interior detail sheets for additional mounting requirements.
 7. Tactile Characters: Characters and Grade 2 Braille raised **1/32 inch (0.8 mm)** above surface with contrasting colors.
- C. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching background color of panel sign.
- D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
1. Panel Material: Opaque acrylic sheet.
 2. Raised-Copy Thickness: Not less than **1/32 inch**.
- E. Engraved Copy: Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy.
- F. Glass Mount Backers: Provide self-adhering vinyl backers at locations where panel signs are applied to glass. Size and shape shall match panel signage.
1. Color: As selected by architect from manufacturer's full range.

2.4 DIMENSIONAL CHARACTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Corporation; Braille-Tac Division.
 2. A. R. K. Ramos.
 3. ASI-Modulex, Inc.
 4. Bunting Graphics, Inc.

5. Gemini Incorporated.
6. Grimco, Inc.
7. Metal Arts; Div. of L&H Mfg. Co.
8. Mills Manufacturing Company.
9. Mohawk Sign Systems.
10. Nelson-Harkins Industries.
11. Signature Signs, Incorporated.
12. Southwell Company (The).

B. Characters: Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free of pits, scale, sand holes, and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated. Comply with the following requirements.

1. Character Material: **Aluminum**
2. Letter Thickness: 3/8" Thick plate
3. Interior Die Character Thickness: 1/2" Thick Plate – radius all curves at 1/4 inch minimum.
4. Height: Varies – Reference Drawings.
5. Typestyle: Reference Drawings.
6. Graphics: Electronic CAD files will be provided to the supplier in order to obtain graphic and actual size and the radius edge for specific patterns. Reference drawings for patterns and colors. Colors to match graphic.
7. Mounting: Concealed studs, noncorroding for substrates encountered.

C. Cutout Characters: Not Used.

D. Dimensional Die Character Signs: Not Used.

2.5 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.6 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

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 shipping.
- 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 the 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 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background and frame colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.

2.10 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Directional Satin Finish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.11 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within **3 inches** of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
 - 3. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 4. Shim Plate Mounting: Provide **1/8-inch**-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.

5. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
 - C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 1. Projected Mounting: Mount characters at projection distance from wall surface 1/2 inch unless noted otherwise.
- 3.3 CLEANING AND PROTECTION
- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 10 14 63 – ELECTRONIC READERBOARD

PART 1 GENERAL

1.1 SUMMARY

- A. (Two) Single-Sided Electronic Exterior Readerboard
- B. Electronic Readerboard Control Software.
- C. Concrete sign base construction and related connection of power and data for a fully functioning sign system.
- D. All sign permit application, coordination, and payment of fees to Authorities having Jurisdiction. Provide shop drawings to AHJ as required for city signage permit. Verify existing easements, right-of-way requirements and property lines prior to starting construction of sign base.

1.2 REFERENCES

- A. Standard for Electric Signs, UL-48, 13th Edition
- B. Standard for Control Centers for Changing Message Type Signs, UL-1433, 1st Edition
- C. Federal Communications Commission Regulation Part 15
- D. National Electric Code

1.3 SUBMITTALS

- A. Delegated Design: Design exterior sign systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Wind Loads: 115 mph, exposure C
 - 2. Seismic Loads: As indicated in the Structural Drawings
 - 3. Mount bottom of sign at 8'-0" above adjacent grade.
- B. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the readerboards and accessories proposed for installation.
- C. Shop drawings: Submit mechanical and electrical drawings.
- D. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Product delivered to jobsite.
- B. Readerboard and accessories to be housed in a dry, clean environment until the time of installation.

1.5 PROJECT CONDITIONS

- A. Environmental limitations: Do not install scoreboard equipment until mounting structure is secure and concrete has ample time to cure.
- B. Field measurements: Verify position and elevation of structure and its layout for readerboard equipment. Verify dimensions by field measurements.
- C. Verify mounting structure is capable of supporting the scoreboard's weight and windload in addition to the auxiliary equipment.
- D. Installation may proceed in acceptable weather conditions.

1.6 QUALITY ASSURANCE

- A. For indoor and outdoor use.
- B. Source limitations: Obtain all readerboard and related equipment through one source from a single manufacturer.
- C. UL Listed
- D. NEC and FCC Compliant

1.7 WARRANTY / SERVICE PLAN

- A. There shall be a one-year coverage of electronic parts with four additional years of extended service coverage.
- B. There shall be an exchange program that provides replacement parts for components that fail during the one-year coverage. To minimize downtime, the exchange parts shall be shipped on the same day that the order is received or on the following day. The manufacturer shall also enclose an air bill for return of the defective components.
- C. There shall be a local Authorized Service Company.
- D. A help desk staffed by experienced technicians and coordinators thoroughly familiar with the readerboard and software shall be available for technical support. This staff is available at no cost to the customer and is on call during weekends.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design: **Daktronics, Inc, Galaxy GS6 19.8mm Full Color**
- B. Other acceptable manufacturer:
 - 1. WatchFire
 - 2. Trans-Lux
- C. Substitutions: See Division 01 – Product Requirements

2.2 PRODUCT

- A. Exterior Reader Boards (two total)
 - 1. **Daktronics Galaxy GS6 19.8mm LED, provide electric power, 120 VAC, single phase electronic readerboard capable of displaying text, graphics, and animations.**
 - 2. **Reader board sign case (full width) with internally illuminated permanent single-sided sign face.**
 - 3. **Quantity: (2) Two-View (Back to Back – two displays)**
 - 4. **Integrate LED displays into reader board assembly as shown in drawing. Coordinate and conceal rear steel clip mounting angles within display assembly.**
 - 5. **Daktronics Venus Control Suite software for Windows based PC.**

2.3 SIGN FACE & READERBOARD

- A. Sign Face/Case
 - 1. Dimensions: 3'-8" high, 8'-1" wide, 5" deep
 - 2. Cabinet Color: Black
 - 3. Feature: Internally illuminated sign face with permanent graphics.
 - 4. Approximate Weight: 210 lbs (each)
 - 5. Metal Trim: Full sheet metal trim enclosure on all sides of the display face(s) to match color of sign assembly.
- B. Features
 - 1. Color: LED RGB
 - 2. Color Capability: 281 trillion
 - 3. Viewing Angle: 140-degree horizontal, 70-degree vertical.
 - 4. Video: AVI, Animated Text, Graphics
 - 5. Brightness: 11,000 NITs Maximum
 - 6. Lines/Character per Line: 10/32
 - 7. UL listed.
- C. Communication Method
 - 1. Fiber based TCP/IP Over Ethernet Communication System
 - 2. Media converter (Media converter requires connection to a 120 vac power outlet.)

3. Provide Ethernet media converter to interface the signal with the owner's network. Owner to provide network configuration settings (IP address, Gateway address, and subnet mask.)
4. Provide multimode fiber for connection to communication box with integrated media converter by the manufacturer. Communications box from manufacture comes with a 30'-0" whip to connect to readerboard display. Multimode fiber to originate in main telecommunications room (TR-MC).

2.4 SOFTWARE

A. Features

1. Spell check for content creation.
2. Text filter to prevent the use of select words during message creations.
3. Import a single or series of images and graphics from a variety of formats.
4. Frame-by-frame user electable presentation effects for entry, hold, and exit transitions.
5. Creation of custom animation through in-program editing tools.
6. Message scheduling to allow pre-programmed start and stop times of messages more than one-year in advance.
7. Multiple messages can run on the display simultaneously, alternating between one and the next.
8. Addition of temperature, date, and time to any message in a variety of formats.
9. Built-in test sequence for display troubleshooting.
10. Automatic adjustment for daylight savings time.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting structure is ready to receive readerboard faces. Verify that placement of conduit and junction boxes are as specified in plans and shop drawings. Verify that all concrete has cured adequately according to specifications.

3.2 INSTALLATION

- A. All power and control cable to readerboard are to be routed in conduit. Power and control wiring to the displays, as well as raceways shown on electrical plans, by the Electrical contractor.
- B. Install readerboard faces to beams / structure in location detailed and in accordance with manufacturer's instructions. Verify unit is plumb and level.
- C. Verify Earth Ground does not exceed 10 ohms.
- D. Install bottom of reader board to be 8 feet above adjacent finish grade. Verify final sign height with Owner.
- E. Verify exact sign location and orientation with Owner prior to installation.

3.3 INSTALLATION – CONTROL LOCATION

- A. Provide boxes, cover plates and jacks in locations per plans.

3.4 TRAINING

- A. Perform one operator training session with end-user identified operators.
- B. Training session to occur on-site.

END OF SECTION 10 14 63

SECTION 10 21 13 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.
 - 2. Solid-polymer shower and dressing compartments
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry" for blocking.
 - 2. Division 10 Section "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.
- D. Product Certificates: For each type of toilet compartment, from manufacturer.
- E. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 75 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.5 WARRANTY

- A. Warranty: Provide Two-Year Warranty.
 - 1. Warranty shall cover installation, operation, materials and labor.
 - 2. Warranty shall commence on date of substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26.

- B. Aluminum Extrusions: **ASTM B 221**.
- C. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
 - 1. Electrolytically Zinc Coated: ASTM A 879/A 879M, **01Z**.
 - 2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvanized.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- E. Stainless-Steel Castings: ASTM A 743/A 743M.
- F. Zamac: ASTM B 86, commercial zinc-alloy die castings.
- G. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, **0.048-inch (1.2-mm)** nominal thickness.

2.2 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Scranton Products, Inc.; Product: Hiny Hider Solid Plastic HDPE
 - 2. Bobrick SCRC series toilet partitions
 - 3. Accurate Partitions Corporation; equivalent to above
 - 4. Bradley Corporation; equivalent to above.
 - 5. General Partitions Mfg. Corp.; ; equivalent to above
 - 6. Global Steel Products Corp. ; equivalent to above
 - 7. Hadrian Manufacturing Inc. ; equivalent to above
 - 8. Knickerbocker Partition Corporation; equivalent to above
 - 9. Sanymetal; a Crane Plumbing company; equivalent to above
- B. Toilet-Enclosure Style: Overhead braced, Floor anchored.
- C. Urinal-Screen Style: Wall anchored and supported
- D. Door, Panel, Screen, and Pilaster Construction: Solid-polymer panel material, not less than **1 inch** thick, seamless, with eased edges and with homogenous color and pattern throughout thickness of material.
 - 1. Hinges: Configure doors and pilasters to receive Institutional Series 8" no-ferrous hinges, full length u-channel support brackets, nylon bearings; throw-bolt surface latch.
 - 2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
 - 3. Color and Pattern: One color and pattern as selected by Architect from manufacturer's full range.
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve matching that on the pilaster.
- G. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.
 - 2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- H. Shower and Dressing Compartments: High density polyethylene (HDPE), waterproof and nonabsorbent, 1 inch thick with radiused edges.
 - 1. Panels: 76" high, mounted to pilasters with continuous brackets and to panels with continuous extruded aluminum brackets or continuous extruded aluminum shower corner brackets.
 - 2. Pilasters: 82 inches high, fastened to panels with continuous brackets.
 - 3. Headrail: Heavy-duty extruded aluminum, anti-grip design, clear anodized finish, fastened to headrail brackets and top of pilaster using stainless steel tamper-resistant Torx head screws.
 - 4. Headrail Brackets: 20 gage stainless steel, secured using stainless steel tamper-resistant Torx head screws.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 3. Coat Hook: Reference and coordinate with 10 28 00 "Toilet, Bath and Laundry Accessories"
 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
 6. Seats: Floor mounted, 1" thick HDPE plastic. Provide (1) in each dressing compartment.
 7. Shower Curtains: Reference and coordinate with 10 28 00 "Toilet, Bath and Laundry Accessories".
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.
- 2.4 FABRICATION
- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at bottoms of posts. Provide shoes and sleeves at posts to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb,

and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 26 13 – CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Corner Guard System.
- B. Related Sections include the following:
 - 1. Division 06 Section "Interior Finish Carpentry" for wood chair rail.
 - 2. Division 08 Section "Door Hardware" for metal armor, kick, mop, and push plates.
 - 3. Division 09 Section "Plastic Paneling" for FRP coordination.
 - 4. Division 09 Section "Gypsum Board" for wall finishes.

1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.
- B. Detail drawings indicating mounting details with the appropriate fasteners for specific project substrates.
- C. Samples for verification purposes of corner guard, 6" long, in full size profiles of each type and color indicated.
- D. Cleaning and maintenance instructions for door and wall protection systems.
- E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall-protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."
 - 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in unopened factory packaging to the jobsite and store in original packaging in a climate controlled location away from direct sunlight.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic sheet material out of direct sunlight.
 - 3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F
 - a. Store corner-guard covers in a vertical position.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall-protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.
- B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

1.7 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. Corner-Guards: provide amount equal to 5 percent of each type, and size of units installed, but no fewer than **(four)**, 6-foot- long units.
- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

- A. Surface-Mounted, Resilient, Stainless Steel Corner Guards: Mechanically anchored formed stainless steel angle; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
 - 1. Available Manufacturers:
 - a. Basis of Design: Construction Specialties, Inc.; **Model CO-8**
 - b. The Corner Guard Store; equivalent to above
 - c. Koffler Sales Company; equivalent to above
 - 2. Guard: Formed stainless steel angle, minimum **16 gauge** wall thickness; as follows:
 - a. Profile: Nominal (two) **2-inch**-long legs and **1/4-inch** corner radius.
 - b. **Height: 6'-0" in length**
 - c. Color and Texture: **#4 Satin finish**
 - d. Alloy: **#304**
 - 3. Coordinate installation of corner guard with rubber base below and wood chair rail above.

2.2 FABRICATION

- A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment.
 - 2. For impact-resistant wall-protection units attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Install with bottom of assembly at top of resilient base trim, and coordinate with adjacent trim conditions at top of installation
 - 2. Coordinate corner guard installation with underlying materials and substrates.
 - 3. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings.
 - 4. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Adjust top height as required to ensure tight seams, and tight butt joints to adjacent finishes and trim pieces.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 13

SECTION 10 28 00 - TOILET, BATH AND HEALTH CARE ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Washroom accessories.
 - 2. Changing Stations.
- B. Owner-Furnished Material: Reference individual items below.
- C. Related Sections include the following:
 - 1. Division 09 Section "Tiling" for ceramic toilet and bath accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty: **Sample of special warranty.**
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.
- C. **Manufacturer's Installation Instructions: Indicate special installation requirements.**
- D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
- B. **Store and handle equipment in a manner to avoid significant or permanent damage to materials.**
 - 1. **Accept equipment on site. Inspect on arrival for damage**
 - 2. **Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.**

1.4 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- C. Furnish exact counts of Owner-Furnished, Contractor-Installed items 60 days in advance of when the materials is needed for the orderly execution of the work. Coordinate in advance with the owner to determine the necessary backing and blocking to allow installation of the specified accessories.
- D. **Field Measurements: Verify actual dimensions of construction contiguous with equipment, including dimensions and heights of installation area, by field measurements before fabrication.**

1.5 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

- A. Provide wash room accessories as specified below, and as shown on the drawings. Not all accessories are shown in the drawings, the work consists of the items and installations defined below. Verify final locations with Owner and Architect prior to installation.
- B. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Bradley Corporation.
 - 3. Or approved substitution in accordance with Division 01 requirements
- C. Toilet Tissue (Roll) Dispenser: *Owner Furnished, Contractor Installed*
 - 1. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation, install at each water closet location.
- D. Paper Towel Dispenser: *Owner Furnished, Contractor Installed*
 - 1. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation, install at each lavatory location.
- E. Soap Dispenser: *Owner Furnished, Contractor Installed*
 - 1. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation, install at each lavatory location
- F. Seat Cover Dispenser: *Owner Furnished, Contractor Installed*
 - 1. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation, install above each unisex water closet location
- G. Grab Bar:
 - 1. Basis-of-Design Product: Bobrick No. B-5806x36, 5806x42 and B-5806x18 at all disabled accessible water closet locations and ADA shower compartments.
 - 2. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation.
- H. Sanitary-Napkin Disposal Units: *Owner Furnished, Contractor Installed*
 - 1. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation, install at each water closet location in female and uni-sex staff restrooms.
- I. Mirror Unit:
 - 1. Basis-of-Design Product: Bobrick B-290 with tempered glass, width indicated in drawings by 48" tall. Other sizes and locations as indicated.
 - 2. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation
 - 3. Locations as indicated in the drawings
- J. Robe Hook:
 - 1. Basis-of-Design Product: Bobrick B-672,
 - a. Provide one on inside face of door at each uni-sex restroom, Coach Restroom, and Referee Restroom.

- b. Provide one on inside face of door at each toilet compartment stall.
 - c. Provide one in each shower dressing compartment.
 - d. Provide as noted in drawings.
 - 2. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation. Mount at 54" above finish floor.
- K. Mop Rack:
 - 1. Basis-of-Design Product: Bobrick B-224, provide at every custodial (mop) fixture.
 - 2. Mounting: Surface mounted, contractor shall coordinate and provide adequate wall backing for installation. Mount at height above finish floor as directed by Owner.
- L. Shower Curtain:
 - 1. Basis-of-Design Product: Bobrick 204-2 Shower Curtain. 42"W x 72"H.
 - 2. Provide hooks with each curtain.
 - 3. QTY: 16
- M. Towel Shelf with Towel Bar:
 - 1. Basis-of-Design Product: Bobrick B-676x24 Surface mounted towel shelf with towel bar.
 - 2. Provide one in each Coach Restroom and Referee Restroom.
- N. Folding Shower/Dressing Area Seat
 - 1. Basis-of-Design Product: Bobrick B-5193
 - 2. Mounting: Surface mounted. Contractor shall coordinate and provide adequate wall backing for installation.
 - 3. Provide one in each Coach Restroom and one in each ADA shower stall.
- 2.3 SPECIAL NEEDS CHANGING STATION
 - A. Basis-of-Design Product: Foundations Worldwide Inc., Model 100-SSE-SM
 - 1. Mounting: Surface mounted.
 - 2. Capacity: 400 lb. load rating
 - 3. Body: 16 gauge, 304 brushed stainless steel, seamless welds.
 - 4. Change surface: Formed polystyrene changing surface.
 - 5. Dispenser: Provide stainless steel liner dispenser.
 - 6. Safety Belt: Smooth nylon safety belt.
 - 7. Supports: Pneumatic gas shock mechanisms for smooth opening and closing.
 - 8. Fully ADA compliant.
- 2.4 UNDERLAVATORY GUARDS
 - A. Manufacturers: Subject to compliance with requirements, provide one of the following products:
 - 1. Plumberex Specialty Products, Inc.
 - 2. TCI Products.
 - 3. Truebro, Inc.
 - B. Underlavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping, and allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded-plastic, white.
- 2.5 FABRICATION
 - A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
 - B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Coordinate details with other work supporting, adjoining, or otherwise contacting items as required to ensure proper installation.
- D. Verify that surfaces and above ceiling supports/backing are installed by the general contractor and are ready to receive work.
- E. Verify exposed finishes have been applied, and setting conditions are dry, clean, and otherwise proper for installation

3.2 PREPARATION

- A. Coordinate size and location of equipment indicated to be attached to or recessed into the building construction, and furnish anchoring devices with templates, diagrams, and instructions for their installation.

3.3 INSTALLATION

- A. General: Install equipment, as required for a complete installation.
- B. Follow all manufacturer's recommendations and requirements for installation of the equipment.
- C. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- D. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.4 ADJUSTING AND CLEANING

- A. Provide systems demonstration under provisions of Division 01. Demonstrate equipment operation.
- B. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- C. Remove temporary labels and protective coatings.
- D. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 41 16 - EMERGENCY KEY CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Lock Boxes.
 - 2. Knox Padlocks

1.2 SUBMITTALS

- A. General: Under the provisions of Division 01, submit the following: Product data consisting of manufacturer's technical data and installation instructions.

1.3 QUALITY ASSURANCE

- A. Verify and comply with requirements of the Local Fire Marshall.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Knox Company
 - 1. Product: Knox-Box 3200-R Recessed, with recessed mounting kit, silver anodized finish.
Qty: Provide (2)
 - 2. Product: Model 3770 – Knox Padlock. Confirm model number with City Fire Department
Qty: Provide (2)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain purchase order application from the Local Fire Marshall.
- B. Purchase units.
- C. Coordinate location and installation with the Local Fire Marshall.
- D. Provide wiring for integration of tamper notification through building security system. Coordinate wiring requirements with electrician.

3.2 INSTALLATION

- A. Install units to comply with manufacturer's instructions.
- B. Connect tamper notification alarm to building security system.
- C. Final acceptance is contingent upon compliance with the Local Fire Marshal requirements. Coordinate exact location with Fire Marshal.
 - 1. The Fire Department requires Knox-box brand FDC caps and plugs. Remote FDC's shall be painted red with an exterior paint.

END OF SECTION 10 41 16

SECTION 10 44 00 - FIRE EXTINGUISHERS & EMERGENCY CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
 - b. AED devices
2. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- C. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 1. Size: **6 by 6 inches** square.
- E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- F. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- G. Maintenance Data: For fire protection cabinets to include in maintenance manuals.
- H. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
- I. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.4 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: J. L. Industries, Inc.; a division of Activar Construction Products Group – Cosmic 6E
 - b. Amerex Corporation, product equivalent to above
 - c. Ansul Incorporated; Tyco International Ltd. , product equivalent to above
 - d. Larsen's Manufacturing Company., product equivalent to above
 - e. Moon-American. , product equivalent to above
 - f. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc. , product equivalent to above
 - g. Potter Roemer LLC. , product equivalent to above
 - h. Pyro-Chem; Tyco Safety Products. , product equivalent to above
 - 2. Valves: Manufacturer's standard
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
 - 5. Finish: Red Enamel
- B. Multipurpose Dry-Chemical Type in Aluminum Container : UL-rated 3-A:40-B:C, **6-lb** nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - b. Amerex Corporation.
 - c. Ansul Incorporated; Tyco International Ltd.
 - d. Larsen's Manufacturing Company.
 - e. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: **ASTM B 209**.
2. Extruded Shapes: **ASTM B 221**.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Clear Acrylic View Window.

2.4 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Basis of Design: J. L. Industries, Inc., a division of Activar Construction Products Group; Panorama Recessed No. 1017Q43V.
 - b. Larsen's Manufacturing Company; equivalent to above.
 - c. Modern Metal Products, Division of Technico Inc.; equivalent to above.
 - d. Moon-American; equivalent to above.
 - e. Potter Roemer LLC; equivalent to above.
 - f. Watrous Division, American Specialties, Inc.; equivalent to above.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Steel sheet.
 1. Shelf: Same metal and finish as cabinet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 1. Square-Edge Trim: **1-1/4- to 1-1/2-inch** backbend depth.
- E. Cabinet Trim Material: Steel sheet.
- F. Door Material: Steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Clear Acrylic. Omit door glazing in all high activity areas (gymnasiums, multi-purpose rooms).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 1. Provide recessed door pull and friction latch.
 2. Provide continuous hinge, of same material and finish as trim permitting door to open 180 degrees.
- J. Accessories:
 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- K. Finishes:
 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet door, and trim except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.

2.5 AED DEVICE CABINET

- A. Cabinet Type: Suitable for AED device.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Basis of Design: Powerheart AED Storage Solutions by Cardiac Science, model #50-00395-20
- B. Cabinet Construction: Nonrated.

- C. Cabinet Material: Steel sheet.
- D. Semi-Recessed Cabinet: Cabinet box semi-recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Cabinet Trim Material: Steel sheet.
- F. Door Material: Steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Clear Acrylic.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Metal cabinet supplied complete with local alarm and highly visible strobe light that are triggered when the door is opened to make it widely-known that an emergency is in progress. Do not wire the alarm into a building's security system. Alarm shall be enabled or disabled with the key provided.
- K. Cabinet Power: Energized for local alarm.
- L. Finishes: Manufacturer's standard baked-enamel paint.
- M. Quantity: (2) Locations. Reference drawings.
- N. Keys: Provide (2) keys with each cabinet.

2.6 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch** thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

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 of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- 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 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils**.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: **54 inches** above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- C. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: **54 inches** above finished floor to top of fire extinguisher.
- D. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 00

SECTION 10 51 13 - METAL LOCKERS & BENCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. New metal lockers, as indicated in the drawings.
 - 2. Locker Accessories, hardware, tops, base, and filler panels.
 - 3. Locker Room Benches

1.2 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 locker and bench.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locker trim and accessories.
 - 2. Include locker identification system and numbering sequence.
- C. Samples for Verification: For metal lockers and locker benches, in manufacturer's standard sizes.
- D. Qualification Data: For qualified Installer.
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- F. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain metal lockers locker benches, and accessories from single source from single manufacturer.
- C. Regulatory Requirements: Where metal lockers and benches shall comply with accessibility requirements, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver master and control keys combination control charts to Owner by registered mail or overnight package service.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.
- B. Field Verify existing lockers to be relocated. Review configuration, mounting and attachment conditions.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for All-Welded Metal Lockers: Lifetime from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than three units:
 - a. Identification plates.
 - b. Hooks.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.
- C. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch steel mesh, with at least 70 percent open area.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
- E. Extruded Aluminum: ASTM B 221, alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
- F. Steel Tube: ASTM A 500, cold rolled.
- G. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- H. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 METAL LOCKERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. All-Welded, Metal Lockers:
 - Basis of Design: DeBourgh Mfg. Co.; Apex Athletic Team Lockers.**
 - a) Provide clasp and latch for owner provided padlock.
 - b) Reference drawings for quantity, size, and locations.
 - b. Art Metal Products; product equivalent to above.
 - c. List Industries Inc.; product equivalent to above.
 - d. Lyon Workspace Products, LLC; product equivalent to above.
 - e. Penco Products, Inc.; product equivalent to above.
 - f. Republic Storage Systems Company; product equivalent to above .
- B. Lockers to be welded unibody construction with exposed welds sanded smooth. No bolts, screws or rivets to be used in assembly of locker units.
- C. Locker Arrangement: ADA Compliant, Single and Double tier.
- D. Material: Cold-rolled steel sheet.
- E. Body: Assembled by welding body components together.

1. Sides and Intermediate Partitions: Constructed of 1-inch by 1-inch by 1/8-inch steel angle iron frame with 16-GA diamond perforated sheet steel welded to steel angle frames. Formed sheet steel locker frames are not acceptable.
 2. Exposed End Panels: Constructed of 1-inch by 1-inch by 1/8-inch steel angle iron frame with 16-GA sheet steel welded to steel angle frame.
 3. Backs: Solid sheet of 18 gauge cold rolled sheet steel welded to frames of sides and intermediate partitions.
 4. Shelves and Tier Dividers: Constructed of 16 gauge cold rolled sheet steel welded to sides and intermediate partition construction. Shelves provided in lockers 48 inches and taller, located to provide a minimum of 12 inches clearance.
- F. Continuous Door Strike: Tier dividers, tops and bottoms constructed of 18 ga. to provide four-sided, continuous door strike for a secure, sanitary and intrusion-free locker while door is in closed position.
- G. Doors:
1. 1-inch x 1-inch x 1/8-inch angle iron frame with inserts of an additional 13-GA steel handle panel with 16GA cold rolled steel back panel securely welded to the center span of the door. All horizontal mesh edges shall be concealed with an additional steel formation welded to the door.
 2. Door Ventilation: 3/4 inch, 13-GA bond sheared expanded metal for maximum ventilation.
 3. Latching
 - a. Latching mechanism operated by a steel handle welded to a three-point cremone type assembly.
 - b. Latching rods, 3/8-inch diameter, engage top and bottom edge of locker frame. A 3/16-inch thick center latch engages door jamb.
 - c. Capable of accepting padlock or built-in lock
- H. Hinges:
1. 14 gauge continuous piano hinge on the right side of the opening.
 2. Hinges welded to both door locker frame.
- I. Base:
1. Concrete base per Division 03.
- J. Reinforced bottom:
1. 16 gauge spacer channel welded to locker bottom front to back. Spacer channel to have full height 1/2"-inch ID tube welded over anchor holes to eliminate deflection.
- K. Filler Panels: Manufacturer's standard 18 gauge solid steel finished to match lockers.
- L. Finish:
1. Complete locker unit to be thoroughly cleaned, phosphatized and sealed
 2. Finish to be baked pure TGIC polyester powder coat with a minimum 2-3 mil thickness.
 3. Color of lockers shall be chosen from manufacturer's full standard colors range.
- M. Accessories:
1. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.
 2. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.
 3. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.
 4. Equip each metal locker with identification plate:
 - a. Furnish each locker with laser etched aluminum number plate.
 - b. Locate number plate near center of each door.
 - c. Owner to furnish numbering sequence.
 5. Single and Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
 6. Upper shelf: Fabricated from 0.048-inch nominal-thickness steel sheet.

2.3 BENCHES

- A. Bench tops to be made of butcher block, Mixed Hardwood 1-1/4 inches thick and 9-1/2 inches wide. Apply double coat of satin-gloss sealer for protection.
- B. Pedestals:

1. Heavy Duty Pedestals: Heavy duty cast iron bell shaped base with a diameter of 7-3/4 inches threaded for 1-1/2 inch pipe. Secure pedestal to the floor with a 1/2-inch by 5-1/2 inch concealed concrete anchor. Overall pedestal height is 16-inches. Misty Gray powder coat is standard, with optional standard color choice available.

2.4 FABRICATION

- A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- D. Accessible Lockers: Fabricate as follows:
 1. Locate bottom shelf no lower than 15 inches above the floor.
 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.
- G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
 1. Sloping-top corner fillers, mitered.
- H. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.
- I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- J. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- K. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- L. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.5 STEEL SHEET FINISHES

- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Powder Coat: TGIC polyester powder coat finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
 - 3. Anchor back-to-back metal lockers to floor.
- B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
 - 4. Attach recess trim to recessed metal lockers with concealed clips.
 - 5. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 6. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 7. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
 - 8. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 13

SECTION 107500-FLAGPOLES

PART 1-GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Tapered Aluminum flagpole, ground mounted.

1.2 RELATED SECTIONS

- A. Division 03 Section Cast-In-Place Concrete for pole footing.

1.3 REFERENCES

- A. AASHTO M-36 - Corrugated Metal Culvert Pipe.
- B. ASTM A53 - Pipe, steel, black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- C. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.

1.4 PERFORMANCE REQUIREMENTS

- A. Flagpole Without Flag: Resistant without permanent deformation to 90 miles/hr; non-resonant, safety design factor of 2.5.

1.5 SUBMITTALS

- A. Product Data: Provide data on pole, accessories and configurations.
- B. Samples: Submit two samples 4 x 4 inch in size illustrating pole material, color and finish.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2-PRODUCTS

2.1 MANUFACTURERS

- A. Flagpole shall be Deluxe Series 25' exposed height aluminum pole with internal halyard, gearless, self-locking winch: as available from Flagpole Country, 2006 E Franklin Rd, Suite 120, Meridian, Idaho 83642, (208) 895-0463, Email: info@idahoflagpole.com.
- B. Approved Substitutes: Morgan:-Francis, Interstate Pole Industries, Concord Industries, Inc., Colonial Specialty, or approved equal prior to bidding.

2.2 POLE CONFIGURATION

- A. Flagpole: Single piece tapered aluminum (ASTM B221, Alloy 6063-T6) tube with 5-inch gold anodized ball top, internal halyard, gearless and self-locking winch. stationary truck and standard spun aluminum collar.
 - 1. Flagpole With Flag: Resistant without permanent deformation to 90 miles/hr; non-resonant, safety design factor of 2.5.
 - 2. Design: Cone Tapered
 - 3. Mounting: Ground Mounted Type
 - 4. Outside Butt Diameter: 6-inches
 - 5. Outside Top Diameter: 3.5-inches
 - 6. Nominal Wall Thickness: 0.188-inches
 - 7. Nominal Height: 25-ft; measured from nominal ground elevation

8. Finish: Satin Brushed followed by a clear Anodized finish per AA-M12C22A42/A44 Class 1
9. Halyard: Stainless steel aircraft cable with two, chrome plated, bronze swivel snap hooks, plastic covered counterweight and beaded sling.
10. External Cleat: With lock box.
11. Truck Assembly: Cast Aluminum; revolving, stainless steel ball bearings, non-fouling.
12. Foundation Tube Sleeve: AASHTO M 36M, corrugated 16 gage steel, galvanized, depth as shown in the Drawings.
13. Pole Base Attachment: Flush, steel base with base cover.
14. 6" Dia. flagpole beacon light with integral revolving truck, Model No. ORN-75-032, with two (2) LED bulbs and a silver finish.
15. Embroidered polyester American flag: 4-FT by 6-FT

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Division 1.
- B. Verify that concrete foundation is ready to receive work and dimensions are as instructed by the manufacturer.

3.2 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

- A. Install flagpole, base assembly and fittings in accordance with manufacturer's instructions.
- B. Fill foundation tube sleeve with sand specified and compact.
- C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.4 ERECTION TOLERANCES

- A. Maximum variation from Plumb: 1 inch (25mm).

3.5 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly. Train Owner personnel in flagpole use.

3.6 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

END OF SECTION 10 75 00

DIVISION 11– EQUIPMENT

Section 11 30 13 Residential Appliances.....2

Section 11 68 24 Field & Track Equipment & Furnishings 6

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Residential appliances
- B. Related Sections
 - 1. Section 06 20 00 and 06 40 23: Interior Architectural Woodwork, for custom casework in areas associated with residential appliances.
 - 2. Division 22 and 23: Mechanical, for connections to equipment.
 - 3. Division 26: Electrical, for power supply, switches and connections to equipment.

1.2 SUBMITTALS

- A. Product Data, including specifications and installation instructions for each type of appliance specified.
- B. Maintenance Instructions: For each type of product installed
- C. Owner's Manual: For each type of product installed

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations.
- B. Certification Labels: Provide appliances that comply with standards and bear certification labels as follows:
 - 1. Energy Star Ratings: Provide energy guide labels with energy cost analysis (annual operating costs) and efficiency information as required by Federal Trade Commission. All appliances shall meet Energy Star Rating.
 - 2. Provide D.O.E. labels denoting energy efficiency, attached to each unit.
 - 3. UL Standards: Provide appliances with UL labels.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store appliances in their original containers, with labels intact and legible.
 - 1. Maintain packaged materials with seals unbroken and labels intact until time of installation.
- B. Do not deliver until finishes in areas of installation are complete and casework or cabinetry has been installed.

1.5 PROJECT CONDITIONS

- A. Coordinate the Work with location and placement of utilities.

1.6 WARRANTY

- A. Provide one year defect-free specialty warranty. Warranty period commences on the date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Appliances: MAYTAG Appliances – see Appliance Schedule at the end of Part 3.
- B. Approved Substitutions as reviewed and accepted by the Owner, prior to bid.

2.2 UTILITY SERVICE

- A. As available for building; refer to Work of Divisions 22, 23, and 26 and the Drawings.
- B. All appliances shall be compatible with new building electrical service.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Verify existing conditions are ready to receive Work of this Section.
 - B. Verify blocking and support backing where required for securing units has been placed within wall framing.
 - C. Verify ventilation outlets, service connections and supports are correct and in required location.
 - D. Verify that electric power of correct characteristics is available.
- 3.2 INSTALLATION
- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals.
 - B. Install materials and systems in proper relation with adjacent construction and with uniform appearance.
 - C. Coordinate with Work of other Sections.
 - 1. Coordinate location of ventilation and power sources.
 - 2. Coordinate location of water supply where required.
 - 3. Coordinate accessible switch locations separate from appliance where specified. See schedule below.
- 3.3 ADJUSTMENT
- A. Adjust appliances and apparatus to ensure proper working order and conditions.
 - B. Remove and replace appliances creating excessive noise or vibration.
- 3.4 CLEANING AND PROTECTION
- A. Wash and clean appliances prior to Substantial Completion.
 - B. Remove masking or protective covering from finish surfaces.
 - C. Polish glass, plastic, hardware, accessories, fixtures and fittings.
 - D. Protect installed appliances from damage by construction operations.
- 3.5 DEMONSTRATION
- A. Test appliances prior to demonstration.
 - B. Demonstrate to Owner operation of all appliances.
- 3.6 APPLIANCE SCHEDULE

Contractor Furnish Contractor Installed Appliances

<u>Item Number</u>	<u>Description</u>	<u>QTY</u>
A. MAYTAG MYS65PN	COMMERCIAL MULTI-LOAD WASHER	(1)
B. MAYTAG MDG78PNCWW	COMMERCIAL DRYER	(1)

END OF SECTION 11 30 13

SECTION 11 68 24 – FIELD & TRACK EQUIPMENT & FURNISHINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

Include all labor, material, equipment, transportation, and services for the supply, assembly, and installation of various items as shown on the drawings and herein specified.

- A. Furnish and Equip Track & Field Event Facilities as follows;
 - 1. Furnish and install four (4) Long-Jump Take-off Boards
 - 2. Furnish and install two (1) Pole Vault Box
 - 3. Furnish and install two (2) Shot Put Throw-Form/Toe Boards
 - 4. Furnish and install one (2) Portable Shot-Put Cage
 - 5. Furnish and install one (1) Discus Throwing Circle
 - 6. Furnish and install one (1) Discus Cage
 - 7. Furnish and install one (1) 3-tier, low-rise portable aluminum bleacher
 - 8. Furnish & install two (2) complete Long/Triple Jump Landing Pit Cover Systems
 - 9. Furnish and install one (1) steeplechase water-jump form, complete, with hurdles
 - 10. Furnish and install one (1) removable competition curb-rail system, complete
- B. Furnish and Equip Football/Soccer Field as follows;
 - 1. Furnish and install one (1) pair NFHS Football Goals including 30' uprights with flags, mounting boxes, and goal post pads with graphics, complete
 - 2. Furnish one (1) complete set of weighted-base football pylons
 - 3. Furnish and install one (1) pair regulation portable soccer goals
 - 4. Furnish and install one (1) pair embedded soccer goal anchors
 - 5. Furnish and install one (1) complete set weighted-base soccer corner flags

1.02 RELATED WORK IN OTHER SECTIONS

- 31 20 00 Earth Moving
- 31 22 16 Field & Track Subgrade Establishment
- 31 46 22 Field & Track Imported Sands
- 32 12 18 Track Asphalt Paving
- 32 13 13 Site Concrete Work
- 32 18 23 Track Rubberized Surfacing
- 32 18 24 Field Synthetic Turf

1.03 SUBMITTALS

- A. The Contractor shall submit for approval: Manufacturer's production information, installation instructions and maintenance recommendations for all components.
- B. The Contractor shall submit for approval of current sieve analysis proposed for use on the project. The sieve analysis shall include the same sieve sizes as those indicated in the specifications and shall be wet sieves as designated in the specifications.

1.04 TESTING

- A. The Owner will be performing testing of materials delivered to the job site for the purpose of verifying compliance with the contract documents. The Owner's testing is for this purpose only and not for construction quality control by the Contractor.
- B. The Contractor shall provide testing and surveillance as required to assure materials and

work fully comply with contract requirements.

PART 2 MATERIALS

2.01 PORTABLE BLEACHERS

- A. 3-Tier Portable Aluminum Bleacher Unit
 - 1. Aluminum angle structure
 - 2. First Seat at 10" height, 6" seat rise, 24" run, single 2x10 footboards, 2x12 clear anodized seat planks.
 - 3. IBC 2009 and ICC 300-2007 compliant.
 - 4. Manufacturer Reference
 - a. Outdoor Aluminum #LDLW-03-21
 - b. L.A. Steelcraft #LA BL0321SA
 - c. Or approved equal.

2.02 FOOTBALL GOALS

- A. Football Goals shall meet National Federation of State High School Associations NFHS/WIAA Regulations in all regards.
- B. Ground Sleeve: The ground sleeve shall be constructed of 8 inch outside diameter Schedule 40 galvanized steel pipe. The ground sleeve shall be a minimum of 5 feet long.
- C. Main Standard (Gooseneck): The main standard shall be constructed from 6 inch outside diameter Schedule 40 6061-T6 aluminum pipe. The pipe shall be curved to provide an 8 foot horizontal offset from the ground sleeve to the crossbar with a 5 foot radius bend.
- D. Crossbars: The crossbar shall be constructed from minimum 6 inch outside diameter Schedule 40 6061-T6 aluminum pipe. The crossbar shall extend 23'-4" in accordance with the NFSHSA requirements.
- E. Uprights: The upright shall be constructed from minimum 4 inch outside diameter Schedule 40 6061-T6 aluminum pipe. The uprights shall extend 30 feet above the crossbar.
- F. Posts, crossbars and uprights to have two-coat catalyzed polyurethane finish or approved equal. Color to be high visibility yellow.
- G. Foundation Access Box: Pre-fabricated aluminum and/or stainless-steel enclosure around ground sleeve goal post connection, to include a lid with opening for the goal as well as lids for use when the goal is removed, both covered with the project synthetic turf system specified elsewhere.
- H. Protective Padding: Provide one (1) set round post protector pads for 6" diameter posts. Pads to be 6" thick cylindrically high-density polyurethane foam with rear cut out for fitting onto post. A minimum nylon reinforced vinyl covert is to be provided to completely enclose foam pad with Velcro closure. Pads to be 6' high. Color shall be RED as approved, , with WHITE vertical lettering "FALCONS" on each pad.
- I. Manufacturer Reference

Football Goal Posts to be Aluminum Athletic Equipment #ASG-HS/8; Sportsfield Specialties Inc. #GP 4380, with anchors, ground sleeves and sleeve caps, or equal.

Aluminum Athletic Equipment
4 Portland Road
West Conshohocken, PA 19428

(800) 523-5471

Sportsfield Specialties, Inc.
13 Ironwood Circle
Coto de Caza, CA 92679
(949) 713-5506.

2.03 PORTABLE SOCCER GOALS

- A. General: Soccer goals to be in full compliance with National Federation of State High School Associations. Goals to provide an 8' x 24' front inside opening. Goals to be portable.
- B. Crossbar and Uprights: The crossbars and uprights shall consist of a single length of 4.5 inch OD 6063 T-5 aluminum D shaped tubing (round face) or 4-3/8 inch OD Rams Aluminum tubing.
- C. The goals shall be finished with a white polyester powder coat finish.
- D. Each goal shall have a wheel kit.
- E. All hardware and fasteners shall be stainless steel.
- F. The goals shall include 4mm polyethylene twine nets.
- G. Warranty: Goals to be warranted by manufacturer for a minimum period of 5 years.
- H. Manufacturer Reference: Soccer goals to be Scoremaster DM2400, Contact (888) 726-7627; Kwik Goal 2B2001 Pro Premier European Match Goal with net, Contact (800) 531-4252; Sportsfield Specialties Model SG4950. Contact 888-408-8638, or approved equal.
- I. Provide one embedded-type soccer goal anchor for each goal,

2.04 SOCCER CORNER FLAG

- A. Furnish at each corner of soccer field, four (4) weighted soccer flags. The soccer flags shall be weighted base, portable type which will topple over on impact. The soccer flags shall be 70" high and shall meet NFSHSA requirements.
- B. Soccer Corner Flags to be
 - 1. Gilman WSF
 - 2. KwikGoal 6B1404
 - 3. or approved equal.

2.05 LONG/TRIPLE JUMP EQUIPMENT

- A. Take-Off Board & Tray Unit shall consist of an aluminum tray, 8" x 48" x 2" permanent recess installation in the track and a 2-3/4" thick dual surface board made up of a reversible top layer of 3/4" marine plywood fastened to 1-1/2" thick aluminum channel. The exposed aluminum channel shall be covered with 1/2" of beige EPDM rubber granules and polyurethane installed by the rubberized surfacing contractor.
- B. Take-Off Board & Tray Manufacturer Reference: Take off board trays to be Aluminum Athletic Equipment Model 8ST with take-off boards to be Aluminum Athletic Equipment Model CTB; Sportsfield Specialties Model No. TFLT008SS, or approved equal.
- C. Furnish and install two take-off boards and trays per runway as indicated in the plans.
- D. Long/Triple Jump Landing Pit Cover System to be a be fabricated, hanging, aluminum trays with field-verified dimensions to provide a clean, uniform, precision fit, with recessed tray to receive the Specified Track & Field Rubberized Surfacing.

- E. Long/Triple Jump Landing Pit Cover System to be:
 - 1. Model "SPCVRCSTMH Custom Hanging Sand Pit Cover Set" manufactured by Sportsfield Specialties, Inc. 41155 State Highway 10, PO Box 231, Delhi, NY 13753 888-975-3343.
 - 2. Or approved equal.
- F. Refer to 31 46 22 Field & Track Imported Sands for Jump Pit Sand.

2.06 PORTABLE SHOT PUT CAGE

- A. Constructed of black powder coated aluminum offset poles set in ground sleeves support nylon safety netting to a minimum height 12' from lowest adjacent grade. Provide secondary safety netting to 6' height around the outside of the installation.
- B. Comply with NFHS Rule 6, Section 4, Article 6 and Appendix A.
- C. Approved Manufacturer model numbers;
 - 1. AAE model SC-14 with BN-SC-14 barrier net.
 - 2. Sportsfield Specialties Inc. (SSI) model no. TF-SPC and TFSCP-BUNET-HS (backup net).

2.07 SHOT PUT TOE BOARD

- A. Unit shall be curved of 3.5' interior radius, 4'0" arc along the inside surface, 4" in height, and 4-1/2" in width.
- B. Board to be of cast aluminum material.
- C. Manufacturer Reference: The shot put stop board shall be Aluminum Athletic Equipment Model ATB (800) 523-5471; Sportsfield Specialties TFSPT002AL (888) 975-3343, or approved equal.

2.08 PORTABLE DISCUS CAGE

- A. Furnish and install a protective discus cage and netting as shown in the plans.
- B. The cage will consist of six (6) 4" O.D. black powder coated aluminum posts, 16' in length, installed in ground sleeves with drain tubing as indicated in the details.
- C. The protective netting shall be attached at the top and bottom of the posts. The netting shall be comprised of 1-3/4" square mesh 14' x 56', reinforced around all edges, and of sufficient strength to withstand repeated impacts from discus throws. An additional protective net, 7' high, of the same material as the primary net shall be furnished and installed around the outer side of the support posts. This net shall be firmly attached at the top and bottom to the support posts. Primary netting shall be installed with hoists to allow for removal and attachment from ground level.
- D. Manufacturer Reference: The discus cage shall be Aluminum Athletic Equipment Model HSDC (800) 523-5471, Sportsfield Specialties TFDCTFHS (888) 975-3343, or approved equal.

2.09 DISCUS PAD & THROWING CIRCLE

- A. Furnish and install a concrete discus pad including an integral aluminum form system and ring as shown in the plans.
- B. The form system shall consist of a 10 foot square and 6 inch high 0.190 inch aluminum sheeting. The form shall include a 2 inch by 2 inch aluminum angle throwing circle that is

securely welded to the form system.

- C. The form system shall include ten (10) 0.625 inch diameter drainage tubes that are welded flush with the depressed section of the concrete pad.
- D. Manufacturer Reference: The discus ring and form shall be
 - 1. Sportsfield Specialties Throw-form System - Discus
 - 2. Aluminum Athletic Equipment DFS-1
 - 3. or approved equal.

2.10 LONG/TRIPLE JUMP LANDING PIT & BASE SAND

- A. The material is intended to be sand oriented and limited in gravel and fines. The gradation stipulated is intended as a guide; therefore, minor variations may be permitted subject to approval by the Engineer of certified sieve sample analysis prior to and during placement of material.
- B. Sand material gradation must meet the following sieve analysis:

Sieve Size	% Passing
No. 3/8"100	
No. 4	75 - 100
No. 1000	- 10
No. 200 (wet sieve)	0 - 5
No. 270 (wet sieve)	0 – 2

2.11 SHOT PUT LANDING AREA

- A. Product shall be a pure red cinder material free of all foreign materials including dirt, gravel or rock of other origin, organic material or trash.
- B. Particle Gradation

Sieve Size	% Passing
# 4	100
#270 (wet sieve)	0 – 5

- C. Source:

Cinder Butte Rock Products
8805 11th St.
Terrebonne, OR 97760
(541) 548-7607

Or approved equal.

2.10 STEEPLECHASE EQUIPMENT

- A. Selected Steeplechase equipment supplier will be responsible for providing all necessary equipment to support the construction of the Steeplechase and water jump facilities including water jump pit/pit form, covers, and hurdles.
- B. Provide Steeplechase Hurdles as a package including 3 at 4m and 1 at 5m width.
- C. Provide Water Jump Pit Covers recessed for installation of synthetic track surfacing by others.

- D. Provide additional pricing for mobility kit, wheels, or carts for Steeplechase Hurdles if available.
- E. All Equipment meets or exceeds NCAA Rule 1, Section 3, Article 5 and all Articles of Rule 2, Section 3.
- F. Preferred Manufacturer model numbers;
 - 1. AAE
 - a. Water Jump Form model WJFS
 - b. Water Jump Cover System model WJC
 - c. Water Jump Hurdle & Seal model WJH-FS
 - d. Steeple Chase Hurdles, package, model PSH-4A
 - 2. Gill
 - a. Water Jump Form model F510 (2010 Facilities Solutions Guide)
 - b. Water Jump Cover System model 730146 (2010 Facilities Solutions Guide)
 - c. Water Jump Hurdle & Seal model 730134 (Seal model 730145B) (2010 Facilities Solutions Guide)
 - d. Steeple Chase Hurdles, package, model 730135
 - 3. UCS
 - a. Water Jump Form model 506-6000
 - b. Water Jump Cover System model 506-5420
 - c. Water Jump Hurdle & Seal model 506-5413 (Seal model 506-5419)
 - d. Steeple Chase Hurdles, package, model 506-5419

2.11 COMPETITION CURB/RAIL

- A. Provide a complete, segmental removable IAAF certified track competition curb/rail system for the inside lane line, including steeplechase water jump pass-through.
- B. Curb to be 6063-T6 extruded structural aluminum, powder coated white.
- C. Curb/Rail to be Gill Model 852P or approved equal.

PART 3 EXECUTION

3.01 LAYOUT & FIELD ENGINEERING

- A. Layout for all embedded competition athletic equipment is to be performed by a Licensed Professional Land Surveyor in coordination and cooperation with the Contract Documents, Approved Manufacturers Printed Installation Instructions, and the applicable NFHS Rule(s) (most recent edition).
- B. Conform to NFHS Requirements for horizontal and vertical tolerance.

3.02 GENERAL INSTALLATION & ASSEMBLY

- A. All products shall be assembled and installed in accordance with the Contract Documents, Approved Manufacturers Printed Installation Instructions, and the applicable Rule Book (most recent edition).

END OF SECTION

DIVISION 12– FURNISHINGS

Section 12 21 13 Horizontal Louver Blinds 4

Section 12 63 13 Aluminum Stadium Bench Seating 3

Section 12 93 00 Site Furnishings 3

SECTION 12 21 13 - LOUVER BLINDS

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Horizontal louver blinds with aluminum slats at interior windows.
 - 2. Horizontal louver blinds with aluminum slats at exterior windows.
- B. Related Sections include the following:
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.
 - 2. Division 08 Section "Aluminum Storefront" for relite window conditions for mounting horizontal louver blinds and accessories.
 - 3. Division 08 Section "Hollow Metal Relite Frames" for relite window conditions for mounting horizontal louver blinds and accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Manufacturer's descriptive literature shall be submitted indicating materials, finishes, construction and installation instructions and verifying that product meets requirements specified. Manufacturers recommendations for maintenance and cleaning shall be included.
- B. Shop Drawings: Show fabrication and installation details for louver blinds. Indicate field-measured dimensions of opening which are to receive blinds, details on mounting surface and sill conditions, and details of corners and conditions between adjacent blinds.
- C. Samples: For each type and color of louver blind indicated.
 - 1. Slat: Not less than 12 inches long.
 - 2. Tapes: Full width, not less than 6 inches long.
 - 3. Louver Blind: Full-size unit, not less than 16 inches wide by 24 inches long.
 - 4. Valance: Full-size unit, not less than 12 inches wide.
 - 5. Cornice: Full-size unit, not less than 12 inches wide.
- D. Product Certificates: For each type of horizontal louver blind, signed by product manufacturer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of horizontal louver blind.
- F. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain louver blinds through one source from a single manufacturer.
- B. Installer: Installer or agent shall be qualified to install specified products by prior experience, demonstrated performance and acceptance of requirements of manufacturer, subsidiary, or licensed agent. Installer shall be responsible for an acceptable installation.
- C. Fire-Test-Response Characteristics: Provide louver blinds 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. Flame-Resistance Ratings: Passes NFPA 701.
- D. Product Standard: Provide horizontal louver blinds complying with WCSC A100.1.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.
- B. Product shall be handled and stored to prevent damage to materials, finishes and operating mechanisms
- C. Materials shall be stored in a clean area, which is free of corrosive fumes, dust, and away from construction activities.

- D. Materials shall be stacked horizontally using plastic or wood shims such that drainage and ventilation are provided for, and such that water cannot accumulate in, about or upon the containers.
- E. Stacks shall be covered with tarpaulins or plastic such that ventilation is provided for, and such that contaminants are prevented from contacting surfaces.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use. Interior temperature shall be maintained between 60° F. and 90° F. during and after installation; relative humidity shall not exceed 80%. Wet work shall be complete and dry
 - 1. Building shall be weather-tight, windows and frames installed and glazed, and interior doors hung.
 - 2. Wet work including concrete, masonry, plaster, stucco, terrazzo, Sheetrock, spackling, and taping (including sanding) shall be complete and dry.
 - 3. Ceilings, window pockets, electrical, and mechanical work above the product shall be complete.
- B. Field Measurements: Where louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 WARRANTY

- A. Lifetime warranty: Louver Blind Manufacturer shall repair or replace for the life of the blind, at its option, without charge, any part found defective in workmanship or material as long as the blind remains in the same window for which it was purchased.

PART 2 - PRODUCTS

2.1 LOUVER BLINDS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Basis of Design: Levolor and LouverDrape, products defined in sections below
 - 2. Hunter Douglas, equivalent to product specified above and below
 - 3. Springs Window Fashions Division, Inc.; equivalent to product specified above and below

2.2 HORIZONTAL LOUVER BLINDS

- A. Levolor Corded Mark I DustGuard 1" corded mini-blind
- B. Materials:
 - 1. Headrail shall be of .025" thick Tomized steel, 1.475" high x 1.625" wide with a crowned underside profile to prevent light leakage. Headrail shall be a valance-free design and shall be coated with a baked-on finish. All headrail detailing shall be high-density polyethylene. All hardware shall be enclosed in the metal headrail.
 - 2. Guardian Tilter mechanism shall be of a not less than .042" thick Tomized steel housing with a self-lubricating nylon, automatically disengaging worm and gear mechanism to provide maximum closure, eliminate overdrive, and prevent strain or damage to blind.
 - 3. Tilt Wand shall be solid, clear, transparent polymer with round cross section of 5/16" diameter. The tilt wand mechanism shall exit the bottom of the headrail via a U-shaped black or bright metal-plated steel link. The tilt wand end contains a split eye machining detail, which facilitates attachment and removal of the wand from the headrail. Provide (18) additional tip wands as extra stock at completion of project.

4. Drum and cradle shall be provided for each ladder.
 - a. Drums shall be of .031" thick Tomized steel having two holes with rolled edges to anchor barbs of both ladder ends
 - b. Cradles shall be of .042" thick Tomized steel having two holes with rolled edges to guide cords through bottom of headrail without abrasion. They shall provide bearing support for the tilt rod, thus preventing the weight of the blind from being transferred to the tilter. Cradles shall center drums over ladder openings.
5. Tilt rod shall be designed to achieve a torsional deflection limit of less than or equal to 6 degrees per 30" length with an applied torque of one foot-pound. A U-shaped tilt rod with a circular radius of approximately 0.125" is used for average blind sizes and lengths. For blinds over 60" wide and under 80" long, or over 55" wide and over 80" long, tilt rod shall be solid D-shaped with an average cross section of 0.28".
6. Installation brackets shall be a combination of 0.048" and 0.036" thick tempered and electroplated steel designed to minimize light gaps. A spring mechanism provides pre-load engagement with the headrail. Brackets shall consist of two interconnecting pieces. One of the pieces is designed for ceiling mount applications and shall be completely concealed within the headrail. A second piece interconnects with the ceiling mount piece to convert the bracket for use in wall mount application.
7. Intermediate brackets shall be of the same design as installation brackets. They shall be installed with blinds over 60" wide and under 80" long, or over 55" wide and over 80" long. Intermediate brackets will be supplied as required.
8. Ladders (slat supports) shall be braided polyester yarn-dyed to Levolor color standard. The two vertical components shall be .076" x .038" designed for maximum flexibility combined with minimum stretch and tensile strength of not less than 50 lbs. per cable. Horizontal components (rungs) shall consist of not less than two cables inter-braided with the vertical components. Ladder shall support the slats without visible distortion. Distance between slats shall not exceed 19.6mm (nominally 15.7 slats per vertical foot). Distance between ladders shall not exceed 23" for blinds up to 80" long. For blinds over 80" long, distance between ladders shall not be greater than 22". Distance between end ladder and end of slat shall not exceed 7".
9. Slats shall be of 5000 series magnesium aluminum alloy only, which includes recycled aluminum materials. Aluminum alloy shall be tempered to optimize tensile and yield strength for superior slat strength, resiliency, and corrosion resistance. Slats shall be nominally 1" wide and .0075"+/- .0003 (prior to coating); after coating the thickness of the slats shall be nominally .0085". Slats shall have a coating thickness of .8 mil to 1.5 mil. Unperforated slats shall perform to 500 hours of 100% relative humidity testing, 300 hours of 5% salt spray solution at 95 degree F testing, and 250 hours of accelerated weathering testing without blistering, fading, corroding, or adhesive failure. Slat thickness and ladder support distances shall prevent visible sag or bow after continued use indoors.
10. DustGuard feature is a permanent, patented paint process that disrupts the natural static attraction of airborne dust particles, reducing dust build up by 50-70 percent.
11. Slats shall be: Unperforated.
12. Bottomrail shall be of 0.029" thick Tomized steel and shall be fully enclosed with color compatible flexible PVC bottom bumper and high-density polyethylene end caps designed to prevent bottomrail from marring windowsill and/or mullions. End caps shall provide hold-down capability designed to prevent bottom bar sway on doors or in windy exposures.
13. Lift Cord shall be braided of high strength, 0.9 mm diameter polyester fiber, 34 picks per inch, 16 carrier smooth braids, and shall be flexible, have minimum stretch, maximum abrasion resistance characteristics, and a minimum breaking strength of 42 lbs. Cord shall be of sufficient length equalized to properly control raising and lowering of blind and spaced not over 46" between cords.
14. Color of blind shall be selected from all available Mark I standard solid colors, Tiltone colors, specialties, or standard metallic slat finishes and complementary standard accessory finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Contractor shall be responsible for inspection of site, field measurements, and approval of mounting surfaces and installation conditions.
- C. Contractor shall verify that site is free of conditions that interfere with blind installation and operation, and shall begin installation only when any unsatisfactory conditions have been rectified.

3.2 INSTALLATION

- A. Installation shall comply with manufacturer specifications, standards, and procedures.
- B. Install louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions. Install intermediate support as required to prevent deflection in headrail.
- C. Provide adequate clearance to permit unencumbered operation of blind and hardware.
- D. Flush Mounted: Install louver blinds with slat edges flush with finish face of opening if slats are tilted open.
- E. Jamb Mounted: Install headrail flush with face of opening jamb and head.
- F. Head Mounted: Install headrail on face of opening head.
- G. Recessed: Install headrail concealed within blind pocket.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.
- B. Demonstrate blinds to be in uniform and smooth working order.
- C. Demonstrate operation method and instruct owner's personnel in the proper operation and maintenance of the blinds.

3.4 CLEANING AND PROTECTION

- A. Clean louver blind surfaces after installation, according to manufacturer's written instructions.
 - 1. Vacuum fabric vanes lightly with brush attachment on a regular basis. Stains may be spot cleaned by sponging gently with mild detergent or fabric cleaner. Ensure proper drying following cleaning by providing adequate ventilation.
 - 2. Clean soiled aluminum and PVC vanes by wiping clean with a mild liquid detergent, soap solution and water only. Window cleaner or cloths with paper content should not be used on aluminum vanes. Do not use abrasive cleansers. Ensure proper drying following cleaning by providing adequate ventilation.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 SCHEDULE

- A. Provide horizontal louver blinds at all locations indicated below:
 - 1. Provide horizontal louver blinds full width and height of windows where shown on Architectural drawing A6.01.

END OF SECTION 12 21 13

SECTION 12 63 13 - ALUMINUM STADIUM BENCH SEATING – BID ALTERNATE #5

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section Includes: Design, fabrication and erection of aluminum bench seating on concrete stadia of size, capacity and features as indicated on the drawings and specified.

1.2 RELATED SECTIONS

- 1. Section 01 23 00 - Alternates
- 2. Section 05 12 00 - Structural Steel Framing
- 3. Section 05 50 00 – Metal Fabrications

1.3 REFERENCES

- A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2004.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
- C. ASTM A 123 / A 123M - Standard Specification for Zinc (Hot-Dip) Coatings on Iron and Steel Products
- D. ASTM A 153 / A 153M - Standard Specification for Zinc Coating (Hot-Dip Galvanized) on Iron and Steel hardware.
- E. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
- F. AWS D1.1 - Structural Welding Code - Steel
- G. AWS D1.2 - Structural Welding Code - Aluminum

1.4 SUBMITTALS

- A. See Section 016000 - Product Requirements, for submittal procedures.
- B. Product Data: As shown on shop drawings
- C. Shop Drawings: Complete layouts with dimensions for fabrication and erection, including plans, elevations and large scale details of typical sections and connections.
 - 1. Provide layout, dimensions and identification
 - 2. Provide location and details of anchorage devices to be embedded in or fastened to other construction. Furnish templates if required for accurate placement.
 - 3. Samples: For each finish product specified, two samples, minimum 18-inch seat sample, representing actual product, color and patterns.

1.5 QUALITY ASSURANCE

- A. AISC Certification: All structural steel shall be fabricated in an AISC certified plant that is certified "BU" – Certified Building Fabricator at the time of bid. The manufacturer bidding the project shall be listed on the AISC website as a certified fabricator prior to bidding.
- B. Manufacturer Qualifications: Obtain required products from a single manufacturer with a minimum of 20 years of experience in the design and manufacture of permanent grandstands.
- B. Installer Qualifications: Installer must be acceptable to or licensed by the manufacturer of products being installed.
- C. Professional Structural Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing

engineering services of the kind required. Engineering services are defined as those performed for installations that are similar to those required for this Project in material, design, and extent.

D. Pre-installation Conference: Prior to installation of work of this section, conduct a meeting at the project site to discuss quality assurance requirements. In addition to the Contractor and the installer, arrange for the attendance of the following:

1. Other installers affected by the work of this section.
2. Manufacturer's representative.

E. Welders: AWS certified.

F. All material and workmanship shall be in accordance with AISC Manual of Steel Construction, Load & Resistance factor Design, 2nd Edition.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 WARRANTY

A. Seating shall be under warranty for a period of one year beginning at Date of Substantial Completion for Projects installed by Manufacturer. The warranty will provide for repair or replacement of failed components due to defect in materials and workmanship of installation for the specified period. This warranty excludes any other defects resulting from abnormal use in service, vandalism, weathering, oxidation, accidental or intentional damage or any occurrences beyond Manufacturer's control.

1.8 MAINTENANCE

A. Owner is to conduct annual inspection and required maintenance of grandstand to assure safe conditions. It is also recommended that a professional engineer or registered architect perform inspections biennially.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Southern Bleacher Company, Inc. (800) 433-0912, www.southernbleacher.com

B. Substitutions: See Section 016000 - Product Requirements.

2.2 STADIUM SEATING

A. Product Description

1. Bench Seating

a. Brackets:

- (1) Tread-mounted aluminum "Z" Bracket spaced no more than 6' apart.

b. Extruded Aluminum:

- (1) Seat: 2x10H 1 3/4" x 9 1/2"
- (2) Joint Sleeve Assembly: Pair of aluminum sleeves to insert in flat plank to maintain true alignment in joining together two plank pieces. Splice cover is unacceptable between two plank pieces joined.

c. Accessories:

- (1) End Caps: End of rows for seat planks, backrests, attached with 5/32 x 5/8 rivets.
- (2) Hold-Down Clip Assembly to attach plank to bracket. Hold-Down Clip: 4-way adjustable, aluminum alloy 6005A-T6 mill finish, 5/16 inch x 1 inch carriage screw, 5/16 inch flange nut.
- (3) Seat Numbers:
 - (a) Decals with black lettering on aluminum field on seats.
 - (b) Rows: Numerals or alphabetical letters, riveted on aluminum plates.
 - (c) Seat Numbers: Numerals.

B. Materials/Finishes

1. Bench Seating

- a. Brackets: Extruded aluminum alloy 6061-T6.
- b. Extruded Aluminum:
 - (1) Seat Planks: Extruded aluminum alloy, 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II. Joint Sleeve Assembly: Extruded aluminum alloy, 6063-T6, mill finish.
 - (2) All-Threaded anchors – Mechanically galvanized rods, nuts and washers.
 - (3) Epoxy – Hilti HY-200
- c. Accessories:
 - (1) Channel End Caps: Aluminum 6063-T6 clear anodized.
 - (2) Hardware:
 - (a) Bolts, Nuts: Hot-dipped galvanized or mechanically galvanized.
 - (b) Hold-Down Clip Assembly: Aluminum alloy 6005A-T6, mill finish.

C. Fabrication:

1. Design Loading:

Per ICC 300-2012 Standard for Bleachers and Grandstands.

 - a. Live Load of Seat: 120 plf.
2. All manufactured connections to be shop welded.
 - a. Manufactured by certified welders conforming to AWS Standards.

PART 3-EXECUTION

3.01 INSTALLATION

- A. All work performed by technicians experienced in stadium seating installation.
- B. Seat brackets bolted directly against concrete treads. No shimming, spacers, or varying brackets to level seats with concrete.
- C. Project as per approved shop drawings.

END OF SECTION 12 63 13

SECTION 12 93 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Scoreboard
 - 2. Play Clock
 - 3. Bollards

1.2 REFERENCES

- A. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2000.
- B. ASTM A 283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2000.
- C. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2000.
- D. ASTM A 325M - Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric); 2000.
- E. ASTM A48 – Standard Specification for Gray Iron Castings.
- F. AWS D1.1 - Structural Welding Code - Steel; American Welding Society; 2000.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product specified, including detailed installation diagrams and recommended installation methods.
- B. Selection Samples: For each product specified, two complete sets of chips representing manufacturer's full range of colors and finishes.
- C. Shop Drawings: Indicate all materials, dimensions, welds, finish, etc. for fabricated items.

1.4 QUALITY ASSURANCE

- A. Furnish paint for touch-up as required.
- B. Install pre-manufactured items, poured-in-place or pre-cast items, and all related materials required to complete the work indicated on the drawings and/or specified.
- C. Materials Inspection: The Contractor shall inspect all items upon delivery to ensure no damage to material or finish. Minor repairs and/or touch up shall be accepted only upon prior authorization from the landscape architect and shall conform, at minimum, to manufacturer's standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Substitutions or equivalent products shall be in accordance with Division 01 and shall be submitted for consideration prior to bidding.

2.2 SITE FURNISHINGS

A. Scoreboard

1. Daktronics, model FB-2027-Football Scoreboard
 - a. Dimensions: 10'Hx32'Wx8"D
 - b. Digit Color: Mixed (Red, Amber)
 - c. Controls: All Sport 5000 Wireless Outdoor
 - d. Horn: 120VAC Trumpet Horn #55 for outdoor scoreboards
 - e. Truss Accent: DA-100-32 w/ Non-Backlit Lettering and Screen Backing.
 - 1) Square Truss, Aluminum, 3' tall x 32' long w/ 50% Non-Backlit Lettering/Logo and Screen Backing.
 - f. Team Name Message Center
 - g. Stat Captions: Electronic
 - h. TOL Captions: Electronic Backlit
 - i. Radio Receiver: 2.4 GHz
 - j. Contractor shall provide adequate mounting beams per manufacturer recommendations.
2. Daktronics: (800) 325-8766 or www.daktronics.com
3. Foundation construction, structural support, and related connection of power and data for a fully functioning scoreboard system.
4. All sign permit applications, coordination, and payment of fees to Authorities having Jurisdiction. Provide shop drawings to AHJ as required for city signage permit. Verify existing easements, right-of-way requirements and property lines prior to starting construction of scoreboard foundation.

B. Play Clock

1. Daktronics, model TI 2015
 - a. Sport Scored: Football, Lacrosse
 - b. Digit Sizes: 24"
 - c. Dimensions (HxWxD): 2'-4"x3'-4"x8"
 - d. Control: All Sport 5000
 - e. Digit Colors: White, Red, Amber
 - f. Cabinet Color Black
 - g. Horn: Mounted inside cabinet behind face
 - h. Radio Receiver: 2.4 GHz
 - i. Power cord and signal jack for portability
 - j. Four-Wheel cart for portability
 - k. Qty: 1

C. Bollards

1. Standard Bollard: Shall be 6-Inch Dia. schedule 40 steel pipe filled with concrete, painted safety yellow and as shown in Drawings.

2.3 FABRICATION

- A. Shop assemble site furnishings for delivery to site in units easily handled and to permit shipment without disassembly.

2.4 ACCESSORIES

- A. Provide all anchorage devices and materials required for a complete installation.

PART 3 -EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Landscape Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Concrete work shall conform with structural concrete specifications. Proper lines and grades are essential.
- C. Assemble, as required, for complete operation in strict conformance with manufacturer's requirements. Notify landscape architect in the event of any discrepancies.
- D. Install as shown on the drawings and in strict conformance with manufacturer's recommendations.
- E. Touch-up paint, as necessary, all blemishes incurred during shipping or assembly, color as designated, to manufacturer's standards.

3.3 ADJUSTING

- A. Upon completion of the installation of site furnishings, check each item and verify that all equipment is properly installed; verify that all trim is in place; adjust all components as necessary to ensure proper operation; remove all labels from equipment.
- B. Make necessary adjustments for safe, efficient and smooth operation.

3.4 PROTECTION

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

3.5 CLEANING

- A. Remove all packing materials from job site.
- B. Clean or restore marred surfaces.

3.6 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

END OF SECTION 12 93 00

DIVISION 13– SPECIAL CONSTRUCTION
Section 13 31 30 Tensile Fabric Facade 14

DIVISION 14 through DIVISION 20 – not used

SECTION 13 31 30 - TENSILE FABRIC FAÇADE – **BID ALTERNATE #2**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes an exterior architectural tensile fabric façade system.
- B. The tensile fabric façade contractor (hereafter referred to as “Subcontractor”) shall be responsible for the structural design, detailing, fabrication, supply, and installation of the work specified herein, some or all of which may be contracted by Subcontractor to others meeting the qualification requirements of Section 1.5. The intent of this specification is to establish in the first instance an undivided, single-source responsibility of the Subcontractor for all of the foregoing functions.
- C. Subcontractor’s work shall include, but not necessarily be limited to, the structural design, supply, fabrication, shipment, and erection of the following principal items:
 - 1. The architectural membrane as indicated on the drawings and in these specifications.
 - 2. Cables and end fittings.
 - 3. Perimeter, catenary, and sectionalized aluminum clamping system.
 - 4. Structural steel, including masts, trusses, struts, beams, and / or weldments, as indicated on the drawings.
 - 5. Fasteners and gasketing.
- D. The architectural membrane used in these structures shall be PVC coated polyester. All references to “membrane” in this section, without exception, and whether singular, plural, capitalized or not, are to such architectural membrane.
- E. Related Sections:
 - 1. 033000 – Cast-In-Place Concrete.
 - 2. 265610 – Exterior Lighting

1.3 REFERENCES

- A. General: Except as otherwise shown or noted, all work shall comply with the requirements of the following codes and standards:
 - 1. American Institute of Steel Construction (AISC).
 - a. Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings
 - b. Code of Standard Practice for Steel Buildings and Bridges
 - c. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design
 - d. Specification for Allowable Stress Design of Single-Angle Members
 - e. Seismic Provisions for Structural Steel Buildings

2. American Society of Civil Engineers (ASCE)
 - a. ASCE 19: Structural Applications of Steel Cables for Buildings
 - b. ASCE 7: Minimum Design Loads for Buildings and Other Structures
3. American Society of Testing and Materials (ASTM)
 - a. ASTM A 586: Standard Specification for Zinc-Coated Steel Structural Strand
 - b. ASTM A 603: Standard Specification for Zinc-Coated Steel Structural Wire Rope
 - c. ASTM A 780: Zinc Rich Paint Repairs
 - d. ASTM A 153: Hot Dip Galvanizing
 - e. ASTM D 4851-88: Standard Test Methods for Coated and Laminated Fabrics for Architectural Use
 - f. ASTM A 36: Carbon Steel
 - g. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - h. ASTM E 84: Standard Test Method and Surface Burning Characteristics of Building Materials
 - i. ASTM 108: Standard Test Methods for Fire Tests of Roof Coverings
 - j. ASTM 136: Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750° C
 - k. ASTM C 423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - l. ASTM E 424: Standard Test Method for Solar Energy Transmittance and Reflectance of Sheet Materials
 - m. ASTM D 1117: Testing Non-Woven Fabrics
 - n. ASTM B 221-08: Standard Aluminum and Aluminum Alloy Extruded Bars
 - o. ASTM B 209: Standard Specification for Aluminum Sheet
4. American Welding Society (AWS)
 - a. AWS D1.1: Structural Welding Code
 - b. AWS 2.4: Symbols for Welding and Nondestructive Testing
5. Aluminum Association
 - a. Specifications for Aluminum Structures
6. National Fire Protection Association (NFPA)
 - a. NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
7. Steel Structures Painting Council (SSPC)
 - a. Steel Structures Painting Manual, Volumes 1 and 2

1.4 SYSTEM REQUIREMENTS

- A. General: Provide a structural tensile fabric façade system that complies with requirements specified herein by testing the Subcontractor's corresponding membrane system in accordance with the indicated test methods.
- B. Building Code Criteria: The tensile fabric façade shall comply with the International Building Code, 2018 edition.

*****PLEASE NOTE ALL BELOW ITEMS WILL MEET IBC 2018 STANDARDS*****

- Ground Snow Load:
- Snow Load Importance Factor:
- Roof Live Load:
- Basic Wind Speed:

- Wind Load Importance Factor:
 - Wind Exposure Category:
 - Seismic Use Group:
 - Seismic Importance Factor:
 - Mapped Spectral Response Acceleration at Short Periods, S_s :
 - Mapped Spectral Response Acceleration at 1-Second Period, S_1 :
 - Seismic Site Class:
 - Damped Spectral Response Coefficient at Short Periods, S_d :
 - Seismic Design Category:
- C. Life Safety: All tensile fabric façades shall be detailed so that no life safety issue is created in the event of a loss of a part of the membrane. The tensile fabric façade shall not rely on the membrane for structural stability.
- D. Design of fabric canopies are to withstand the most critical effects of load factors and load calculations.
- E. Fire Performance: Range of characteristics required of membranes:
- | | |
|---|----------------|
| 1. Burning Characteristics (ASTM E 84) | |
| a. Flame Spread | 5 max. |
| b. Smoke Generation (Tunnel Test) | 20 max. |
| 2. Flame Resistance (NFPA 701 Small Scale, UL 94) | |
| a. Flame Out | 1 sec. after |
| b. Char Length | 0.25-inch max. |

1.5 QUALITY ASSURANCE

- A. Subcontractor Qualifications: Fabrication and erection of the tensile fabric façade is limited to firms with proven experience in fabrication and construction of complex tensile fabric façade. Such firms, through their own experience and/or that of their qualified subcontractors, shall meet the following minimum requirements:
1. The Subcontractor shall have at least ten (10) years' experience in the successful fabrication and erection of permanent, custom tensile fabric façades.
 2. The Subcontractor shall have fabricated and erected at least twenty (20) PVC coated polyester tensile fabric structures, with at least five (5) structures of similar size and complexity as this project.
 3. Demonstrate it has maintained an in-house professional engineering design staff for at least ten (10) years, and will provide final engineering drawings that have been prepared by licensed Professional Engineers in its employ.
 4. The Subcontractor shall demonstrate it has a fabrication facility of adequate capacity and a staff experienced in the fabrication of PVC coated polyester tensile fabric structures that will undertake the fabrication of this project.

1.6 SUBMITTALS

- A. Submit under provision of Section 013300 – Submittal Procedures.

- B. General: Notwithstanding any provisions of these specifications that may appear to be to the contrary, any and all submittals by the Subcontractor shall be subject to review, approval, and adoption by the Architect/Engineer as part of the overall project design and engineering, and shall not create a contractual or other professional design relationship between the Subcontractor and either the Architect/Engineer or the Owner.
- C. Product Data: Include manufacturer's specifications for materials, fabrication, installation, and recommendations for maintenance. Include test reports showing compliance with project requirements where test method is indicated.
Sample: Submit selection and verification samples.
- D. Design Drawings: Subcontractor shall submit tensile fabric façade drawings defining the completed structure, anchorage, and connection details, interfaces with building construction and general membrane seam arrangements. Design Drawings are to be signed and sealed by a Professional Engineer in the State of WA.
- E. Design Calculations: Subcontractor shall submit complete calculations for the tensile fabric façade, as one package with the design drawings, signed and sealed by a Professional Engineer licensed in the State of WA. Structural calculations shall include all required loading cases and load combinations used in the design and resulting member forces, reactions, deflections and drift. The magnitude of maximum reactions on the supporting structures from all critical load combinations shall be separately tabulated. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer to answer questions during the design drawing review.
- F. Quality Assurance Submittals
 - 1. Test Reports: Provide test reports from a qualified testing laboratory that show compliance of the Subcontractor's PTFE-coated woven fiberglass tensile membrane system with specification requirements, as follows:
 - a. Physical test data of the actual fabric roll goods to be used in the project confirming conformance with specifications for the membrane.
 - 2. Certificates: Product certificates signed by the Subcontractor certifying materials comply with specified characteristics, criteria, and physical requirements.
- G. See Section – 17000 – Close-out Procedures: Submit the following items:
 - 1. Warranty: Project Warranty documents as described herein.
 - 2. Record Documents: Project record documents for installed materials in accordance with Contract Conditions and Division 1 Submittal Procedures Section.
 - 3. Maintenance Manual: Submit one (1) copy of a maintenance manual for the tensile fabric façade to the owner. The manual shall include a schedule for routine inspection, and inspection checklist, instructions for emergency repair and use of emergency repair materials, and warranty. During the system erection period, the owner shall provide maintenance personnel to be trained in the use of repair materials.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. See Section – 016000 – Product Requirements.

- B. Materials shall be packed, loaded, shipped, unloaded, stored and protected in a manner that will avoid abuse, damage, and defacement.

1.8 WARRANTY

- A. The Subcontractor shall furnish the Owner with a written warranty, which warrants the façade membrane, its perimeter attachment system, and the structural support system as supplied by the Subcontractor have been installed in accordance with the project specifications and will be free from defects in materials and workmanship that will impair their normal use of service. The warranty shall start from the date of substantial completion of the tensile fabric façade; which shall be the first date on which the entire tensile fabric façade is subject to design pre-stress conditions, and continue for a period of one (1) year thereafter.
- B. One (1) year workmanship warranty on installed products
Ten (10) year structural warranty on structural steel and cables
One (1) year warranty on paint system
Manufacturer's standard pass thru warranty on fabric

PART 2 – MATERIALS

2.1 QUALIFIED CONTRACTOR

- A. *Pfeifer Structures LLC*
ATTN: Erik Jarvie
1011 Regal Row
Dallas, TX 75247
Tel: (714) 800 4747
Email: erik.jarvie@pfeifer-structures.com
- B. Or approved equal. Substitution requests must be submitted by a prime bidder a minimum of ten (10) days prior to bid date. Any approved equals shall be issued by addendum only, prior to the bid date.
- C. Approved bidders must meet all qualifications in Section 1.5 – Quality Assurance and show written proof for each item listed to become an approved equal.

2.2 TENSILE FAÇADE MATERIALS

- A. General: The membrane used in these façades shall be a PVC coated polyester fabric. All references to “membrane” in this section, without exception, and whether singular, plural, or capitalized or not, are to such architectural membrane.
- B. The membrane shall meet the following general requirements:
 - 1. Source Quality Control: The primary materials shall be obtained from a single manufacturer. Secondary materials shall be those recommended by the primary manufacturer.
 - 2. Physical Characteristics: The following indicates a range of physical property types for PVC façade membranes. The determination of specific characteristics and selection of a

membrane shall be derived from analysis and calculations carried out by the Professional Engineer for this project.

a. Coated Fabric Weight (oz/sq. yd) (ASTM 4851)	12-45.5 nom.
b. Thickness (mils) (ASTM 4851)	17 – 36 nom.
c. Strip Tensile (lbs./in.,avg.)	
1) Dry, Warp (ASTM 4851)	250 min. – 975 min. avg.
2) Dry, Fill (ASTM 4851)	250 min. – 900 min. avg.
d. Trapezoidal Tear (lbs. avg.)	
1) Warp (ASTM 4851)	35 min. – 95 min. avg.
2) Fill (ASTM 4851)	35 min. – 120 min. avg.
e. Solar Transmission (%) (ASTM 424)	0 – 25 nom.
f. Solar Reflectance (%) (ASTM 424)	4 – 75 nom.
g. Openness Factor (%)	20 - 30
h. Fabric Color	White for printing

C. Materials

1. Base Fabric: The yarns used shall be of the highest commercial quality, essentially free of broken fibers and fully suitable for coating. The fabric shall be woven with uniform tension and crimp in the warp and fill yarns and free of defects deleterious to the coating process.
2. PVC Coatings: The coating materials shall be PVC formulated specifically for architectural applications.
3. After weaving, the base fabric shall be cleaned and primed to achieve optimum mechanical properties of the coated membrane. The coating, described above, shall be virtually free of mud cracks and pinholes. The coating shall be applied evenly to both sides of the fabric.

D. Printing

1. Graphics files shall be supplied by designer, architect, or artist
2. Acceptable file formats are:
 - a. Adobe Photoshop (.psd or .tif)
 - b. Adobe Illustrator (.ai or .eps)
 - c. Adobe Acrobat (.pdf) – uncompressed
3. Resolution
 - a. Images within 10 feet viewing – 200dpi
 - b. Images beyond 10 feet – 50dpi, no more than 100dpi
4. Color
 - a. Supply all full-color files in CMYK color space
 - b. Spot or Pantone colors should be converted to process color equivalents.
 - c. When black is used in the design, a built-up black of CMYK is required

2.4 ALUMINUM EXTRUSION SYSTEM

A. Materials

1. All structural aluminum clamping and extrusion systems shall be ASTM alloy 6061-T6.
2. Bent Plates shall be formed from ASTM B 221-08 alloy 6061 and then heat-treated to T6.
3. All aluminum clamping and extrusion shall have the following finish:

- d. A welding procedure must be submitted to the Subcontractor for approval of welds that are not pre-qualified.
- e. Shop drawings shall be carefully checked before being submitted for approval, and shall be submitted in the order in which they are needed for the executive of the work, well in advance and not all at one time. Submitted drawings shall show all structural steel required for the work, whether or not indicated on the drawings.
- f. The fabricator shall not fabricate any material until after receipt of approved shop drawings.
- g. The fabricator shall immediately make all corrections to his drawings as required by the Subcontractor and shall keep a satisfactory history of all changes by separately numbered and dated revision block on a convenient portion of each drawing affected.
- h. Certification of material conformance that includes chemical and physical properties for all structural elements shall be submitted to the Subcontractor.

D. Materials

- 1. Structural steel for plates and bars shall conform to the requirements of ASTM A 36 or ASTM A 572, Grade 50, unless noted otherwise.
- 2. Structural pipe shall conform to ASTM A 53, Types E or S, Grade B.
- 3. Structural tubing shall conform to ASTM A 50, Grade B or C.
- 4. Structural bolts
 - a. High strength bolts: ASTM A 325, unless noted otherwise
 - b. Common bolts and nuts: ASTM A 307
 - c. Threaded rods: ASTM A 36, unless noted otherwise
- 5. Other materials: All other materials, not specifically described but required for a complete and proper installation of structural steel, shall be provided and shall be new, free from rust, first quality of their respective kinds, and subject to the approval of the Subcontractor.

E. Accessories

- 1. Base Plates and Anchor Bolts
 - a. Base plates supported on concrete, whether shop attached or shipped loose, shall be furnished and set on shims or leveling plates. Grouting shall be by the General Contractor.
 - b. Anchor bolt locations shall be furnished by the Subcontractor and used by the General Contractor to set the bolts. The General Contractor is to check carefully the setting of the bolts to their proper position prior to pouring of concrete. Anchor bolts, provided by the General Contractor, shall have two (2) nuts and washers. Damaged threads shall be repaired or be cut to permit full tightening of nuts.

F. Fabrication

- 1. Workmanship: All members when finished shall be true and free of twists, bends, and open joints between the components parts. Members shall be thoroughly straightened in the shop by methods that will not injure them, before being worked on in any way.
 - a. Properly mark materials, and match-mark when directed by the Subcontractor, for field assembly.
- 2. Connections:
 - a. Connections shall be as indicated on the drawings. When details are not shown the connections shall conform to the requirements of the AISC.
 - b. Provide high-strength threaded fasteners for all structural steel bolted connections, unless noted otherwise.

- c. Combination of bolts and welds in the same connection are not permitted, unless otherwise detailed.
- d. Welded Connections
 - 1) Definitions: All terms herein relating to the welds, welding and oxygen cutting shall be construed in accordance with the latest revision of "Standard Definitions of Welding Terms and Master Chart of Welding Processes" of the AWS.
 - 2) Operators: only operators who have been previously qualified by tests, as prescribed in AWS D1.1 to perform the type of work required shall make Welds.
 - 3) Welding equipment shall be of sufficient capacity and maintained in good working condition, capable of adjustment in full range of current settings. Welding cables shall be adequate size for the currents involved and ground methods shall be such as to insure proper machine operation.
 - 4) No welding shall begin until joint elements are clamped in proper alignment and adjusted to dimensions shown on the drawings and allowance for any weld shrinkage that is expected. No members are to be spliced without prior approval.
 - 5) All welding shall be done in accordance with the reference specifications, with the following modifications and additions:
 - a) All field welding shall be done by manual shielded metal-arc welding.
 - b) All groove welds shall have complete penetration, unless otherwise specified on the drawings.
 - c) The minimum preheat and inter-pass temperature requirements shall be as required per AWS D1.1.
 - 6) Welding Sequence: Heavy sections and those having a high degree of restraint must be welded in a sequence with the proper preheat and post-weld heat treatment such that no permanent distortion occurs. Submit a welding sequence for approval for these types of connections.
 - 7) Oxygen Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. Alternatively, an unguided torch may be used provided the cut is not within ½ inch of the finished dimension and the final removal is completed by chipping or grinding to produce a surface quality equal to that of the base metal edges. The use of oxygen-cut holes for bolted connections will under no circumstances be permitted and violation of this clause will be sufficient cause for the rejection of any pieces in which oxygen-cut holes exist.
- 3. Tolerances: All tolerances shall be as per the AISC "Code of Standard Practice for Steel Buildings and Bridges".
- 4. Paint System, Two-Part:
 - a. Source Quality Control: Primary materials shall be obtained from a single manufacturer. Second materials shall be those recommended by the primary manufacturer.
 - b. Surface Preparation and Base Coat
 - 1) The surface shall be commercial blast cleaned in conformance with SSPC-SP10/NANCE 2, after all fabrication operations such as machining and welding are completed. There shall be no more than an eight hour time lapse between the surface preparation and the application of the prime coat.
 - 2) The base coat shall be Sherman Williams Macropoxy 646 PW color mil white or light blue or approved equal, and shall conform to SSPC-Paint 22.

- 3) The base coat shall be mixed and applied in accordance with the manufacturer's instructions and shall meet the requirements of SSPC Paint Specification No. 22. The minimum thickness shall be 2.0 to 4.0 mils dft.
- c. Finish Coat
 - 1) The finish coat shall be Sherman Williams Hi-Solid Polyurethane (semi-gloss) or approved equal, and shall conform to SSPC-paint number 36, level 3.
 - 2) The finish coat shall be mixed and applied in accordance with the manufacturer's instructions and the minimum thickness shall be 3.0 to 4.0 mils dft.
- d. Two-Part System Thickness: The minimum system thickness shall be 8.0 mils dft.
- e. Color: The paint color shall be as selected by the Architect
- f. Finish Quality: The dry paint shall be uniform and continuous with no voids or puddles and shall not be broken by scratches or nicks. Although the Subcontractor's Quality Assurance personnel may witness the painting operation, this does not relieve the painting subcontractor of the responsibility for meeting the quality and workmanship requirements of these specifications.
- g. Care and Handling: The painting subcontractor shall make every reasonable effort to ensure that the painted steel is thoroughly dry and that it is handled carefully to prevent damage to the paint and to reduce field repairs. Nylon slings should be used when handling the painted steel.
- h. Certification: The painting subcontractor shall be required to certify the paint manufacturer's name, paint identification, conformance with manufacturer's written instructions and the paint dry mil thickness.

G. Source Quality Control:

1. Testing

- a. An independent testing laboratory paid for by the owner shall perform testing and inspection of the structural steel and welding. All welds shall be tested by visual, dye penetrant, magnetic particle methods in accordance with instructions from the Subcontractor.
- b. The Subcontractor and the testing laboratory inspector shall be permitted to inspect the work in the shop or field throughout fabrication and erection.
- c. The inspector shall check for workmanship of steel, both in the shop and field, and check general compliance with the contract documents and steel shop drawings. The inspector shall record types and locations of all defects found in the work and measures required and performed to correct such defects.
- d. The steel fabricator shall make all repairs to defective work to the satisfaction of the inspector and at no additional cost to the Subcontractor.
- e. The inspector shall submit reports of his inspection and test findings to the Subcontractor. He shall record all defects found with the subsequent repair operations and submit reports to the Subcontractor.
- f. The work of the independent inspector shall in no way relieve the steel fabricator of his responsibility to comply with all requirements of the contract documents.

H. Product Handling and Protection: Use all means necessary to protect structural steel before, during, and after installation, and to protect the installed work and materials of all other trades.

I. Rejection and Replacement:

1. In the event of damage to the steel, immediately make all repairs and replacements necessary to the approval of, and at no additional cost, to the Subcontractor.
 2. Any materials or welding rejected through inspection either in the shop, mill, or field must be promptly replaced to the satisfaction of, and at no additional cost to, the Subcontractor.
- J. Qualifications of Steel Fabricator: The steel fabricator shall have not less than five (5) years continuous experience in the fabrication of structural steel.

2.6 FASTENERS

- A. General: Provide fasteners used to secure clamp systems to curbs and cables, assemblage of clamp systems, and other fasteners as required to complete the work specified herein.
- B. Materials:
1. All work shall comply with the latest edition of ASTM standards and American Iron and Steel Institute (AISI), as referenced herein.
 2. Fasteners used in membrane clamping systems shall be stainless steel. Bolts and studs shall conform to ASTM F 593, type 304. Nuts shall conform to ASTM F 594, Type 316. Washers shall be plain, narrow, and conform to AISI Type 18-8.
 3. All clamping systems subjected to relative movement between clamping and curb shall receive a split-ring lock washer conforming to AISI Type 18-8.
 4. Unless otherwise specified on the drawings, all other bolts and nuts shall conform to ASTM A 307-76B, zinc plated to conform to ASTM B 633 Class FE/ZN 8 type III.
 5. Concrete fastener material shall be carbon steel Blue Climaseal® coated or approved equal. Thread type shall utilize Threadform Technology™ or approved equal.
- C. Source Quality Control: The manufacturer shall certify that all fasteners comply with the above referenced specifications.

2.7 GASKETING

- A. General: All work shall comply with the latest edition of ASTM standards, as referenced herein.
- B. Sponge Neoprene Gasketing:
1. Material
 - a. All sponge neoprene shall be of a cellular elastomeric compound of a firm grade, which has been manufactured in pre-formed shapes for use as gasket and sealing material, as specified in ASTM specification C 509.
 - b. Cellular elastomeric materials furnished to this specification shall be manufactured from natural or synthetic rubber, or mixtures of these, with added compounds of such nature and quality that, with proper curing, the finished product will comply with this specification.
 - c. The cured compounds shall be suitable for use where resistance to sunlight, weathering oxidation and permanent deformation under load are of prime importance.
 - d. The manufacturing process shall be such as will ensure a homogeneous cellular material free of defects that may affect serviceability.

- e. The physical characteristics of the neoprene must meet or excess ASTM C 509, "Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Materials."
- f. Certification of material shall be provided that conforms to ASTM C 509.

C. Dense Neoprene Gasketing:

1. All neoprene material shall conform to ASTM D 2000M hardness Grade 60. The material shall be homogenous, free from defects and shall be compounded and cured to meet the requirements specified herein.
2. All neoprene shall be non-staining formulation and shall consist of at least 50 percent by weight of basic rubber hydrocarbon. Material shall not contain crude or reclaimed rubber.
3. The physical characteristics of the neoprene must meet or exceed the following physical test requirements when tested using the standard ASTM test slab can compression set plug (or approved equal):

PROPERTY	ASTM METHOD	UNITS
a. Shore A Durometer	D2240	55-65
b. Tensile Strength (Min.)	D 412	1,100 psi
c. Percent Elongation (Min.)	D 412	300%
d. Percent Compression Set (Max.)	D395, Method B, 22hrs at 212° F	35%
e. Heat Aging, Change from original properties:		
• Hardness Change (Max.)	+15 Points Shore A	
• Tensile Strength (Max.)		-15%
• Elongation Change (Max.)	-40%	
f. Flame Resistance		Must not propagate flame
g. Temperature Range		-30°C to -100°C
h. Ozone Resistance	D1171, Method A, 72 hrs @ 38°C and 50 mPa Ozone	
i. Resistance to Oil Aging:	D471, 70hrs @ 212°F Immersion in ASTM Oil No.3	
• Tensile Strength (Max.)		-70%
• Elongation (Max.)		-55%
• Volume Change (Max.)		+120%

2.8 PVC MAINTENANCE KIT

- A. Architectural Membrane Maintenance Kit: The owner shall be supplied with the following materials for emergency repair or maintenance. The materials shall be neatly packaged into a maintenance kit for storage by the owner.

QUANTITY	DESCRIPTION
• 6	12-inch diameter PVC fabric patch
• 12	5-inch diameter PVC fabric patch
• 12	4-inch x 8-inch rectangular PVC fabric patch
• 6 sq. yds.	Outer Membrane
• 1	Hand-held PVC hot air welder
• 1	Hand-held PVC roller
• 2	Insulating bearing blocks
• 1	5/8-inch hole punch
• 1	Utility knife

- 50 Repair clips
- 1 Spool of No. 36 nylon twine
- 36 yds. Comar B29/4 x 15 Kevlar® thread
- 1 Hand awl
- 1 pkg. C-29 needles
- 1 Repair Manual

PART 3 – FABRICATION AND ERECTION

3.1 FABRICATION OF MEMBRANE PANELS

A. General

1. Membrane assembly design drawings shall include all information necessary for the fabrication by the Subcontractor of the tensile fabric façade. They shall include size and shape of envelope, type and location of shop and field connections, size, type and extent of all heat-welded seams.
2. The Subcontractor shall take necessary care to plan and assemble the fabricated sections such that the assembly has not shop patches. Splices, if any, shall be patterned into a symmetrical and repetitive geometric arrangement within the assembly, shown on the design drawings and, where feasible, hidden by structural members.
3. All fabricated joints shall have a minimum of 90 percent of the total strength of the coated membrane in strip tensile testing. All structural joints shall be fused in accordance with industry standards and shall maintain the integrity of the coating. PTFE-coated woven fiberglass membranes shall be heat-sealed only.
4. Biaxial Test: At least one (1) representative sample of the outer membrane shall be biaxially test loaded. Membrane compensation in patterning shall be based upon results of the biaxial test loading.

3.2 ERECTION OF MEMBRANE ASSEMBLIES

- A. Prior installation of the membrane assemblies, the Subcontractor shall meet with the General Contractor to review the erection procedure and scheduling. The Subcontractor shall coordinate all work with other trades.
- B. No trade shall have access to, or work from the membrane, unless authorized by the Subcontractor in writing.
- C. Erection of structural steel
 1. The Subcontractor shall employ a competent foreman to supervise all work of steel erection. This foreman shall be present at all times during the Subcontractor's scope of work.
 2. All precautions shall be taken to ensure an accurately located and completely safe and stable structure at all times. Adequate guy cables shall be used throughout the work and all erection bolts shall be drawn up tight.
 3. All steel shall be accurately aligned before permanent connections are made.
 4. Temporary bracing shall be left in place as long as may be required for safety. The bracing shall be located so it does not interfere with the erection for the tensile fabric façade and can be removed as required during construction.

- a. The structure is to be self-supporting and stable after the structure is fully completed. It is the Subcontractor's sole responsibility to determine the erection procedure and sequence and to ensure the safety of the structure and its component parts during erection. This includes the additional of whatever temporary bracing, guys or tie-downs that may be necessary. Such materials shall be removed by the Subcontractor and remain his property after completion of the property.
5. Erection tolerances shall be specified in the AISC "Code of Standard Practice for Steel Buildings and Bridges", unless otherwise noted.

3.3 CLEANING

- A. Protect work from damage and deterioration during installation.
- B. Upon completion of tensile fabric façade installation:
 1. The Subcontractor shall clean all surfaces of the system's components in conformance with the membrane manufacturer's recommendations.
 2. Inspect the system and repair membrane panels that become damaged. Repairs shall be executed in such a way that they are visually acceptable.
- C. Repairs:
 1. Inspect the system and repair membrane panels that have become damaged.
 2. Repairs shall be neatly made and shall not exceed 12 inches in diameter. Repairs shall be limited to one of each 3,000 square feet of fabric and no more than 10 repairs for the entire shade structure system.
- D. Steel Cleaning:
 1. Cleaning and touchup steel finishes field welds, bolted connections and abraded areas shall be completed per the manufacturer's field repair recommendations.

END OF SECTION - 13 31 31

DIVISION 21– FIRE SUPPRESSION
Section 21 10 00 Fire Protection..... 11

SECTION 21 10 00 - FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all materials, labor, equipment design and services necessary to perform the installation of the fire protection system as shown on the drawings and as described herein.
 - 1. (Wet system) Grandstand conditioned space: Architect specified finish color, semi-recessed sprinklers in the finished ceilings
 - 2. (Dry system) Grandstand Mezzanine unconditioned space: Architect specified finish color, sprinklers in unfinished space without ceilings open to structure.

1.2 RELATED DOCUMENTS

- 1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Sections, apply to work of this section.
- 2. The following Sections contain requirements that apply to portions of this Section:
 - 1. Section 23 – General Provisions.
 - 2. Section 26 – Fire Alarm Systems.

1.3 CODES AND STANDARDS

- A. Comply with the requirements of the most current version of the following, as applicable:
 - 3. NFPA 13: Standard for installation of Sprinkler Systems.
 - 4. NFPA 14: Standard for installation of Stand Pipes.
 - 5. NFPA 24: Private Fire Service Mains.
 - 6. Washington Administrative Code (WAC).
 - 7. International Building Code (IBC).
 - 8. International Fire Code (IFC).
 - 9. Uniform Plumbing Code (UPC).
 - 10. International Mechanical Code (UMC).

1.4 SCOPE

- A. The meaning and intention of these specifications, in conjunction with the drawing(s), is to cover a completely installed, fully operating fire protection system for the entire building. To accomplish this purpose, the Contractor shall provide all design, materials, equipment, labor necessary and required, and bear all expenses incidental to the satisfactory completion of the work.
- B. It shall be the Contractor's responsibility to design and install the system so that no interference's exist between the fire protection piping, and equipment and systems designed and installed by others. The latest issues of all architectural, structural, mechanical and electrical drawings are available to assist the Contractor in preparing the design so as to avoid interference's.
- C. The Contractor shall become familiar with all details of the work, verify all dimensions, and shall advise the Engineer of any discrepancies before submitting his bid.

- D. Comply with all applicable local codes, state and local Fire Marshal's standards, International Building Code, International Fire Code, and NFPA 13 for installation of systems.
- E. The design shall be governed first and foremost by code compliance and secondly by the specifications and contract documents. If a discrepancy exists between code and contract documents, the stricter shall be complied with. If such discrepancy exists, notification is expected and an addendum will be issued.

1.5 DESIGN CRITERIA

- A. The Contractor shall develop full sets of shop drawings and final hydraulic calculations. These drawings shall show heads and piping coordinated with the final reflected ceiling plan and ductwork.
- B. The design shall be in accordance with IFC Chapter 9, Section 903 "Automatic Sprinkler Systems".
- C. Provide dry type heads or dry pipe systems in locations subject to freezing conditions.
- D. Anti-freeze systems are not acceptable without specific approval from architect and owner.

1.6 SUBMITTALS

- A. Product Data: Furnish a complete list of fire protection equipment and products, and manufacturers catalog data sheets and maintenance data sheets for each item to be included in the project.
- B. Shop Drawings: Submit drawings identified as "Working Drawings", which have been prepared in accordance with NFPA 13, including hydraulic calculations, and which have been approved by the authority having jurisdiction. See Section 15000 for coordination requirements with other trades. Submittal drawings to contain locations of lights, ductwork, diffusers, etc. along with pipe routing and sprinkler heads. Any light fixtures which hang below the ceiling surface shall be noted with the depth that they extend below the ceiling surface. AutoCAD drawings of HVAC systems designed by KARTCHNER ENGINEERING, PLLC. are available to assist in this process. Submit evidence of final drawing approval by the authority having jurisdiction prior to the start of fabrication or installation.
- C. Test Reports: Contractor shall perform hydrostatic testing of all system piping in accordance with NFPA Pamphlet 13. Provide complete Contractor Material and Test Certificates for each system/portion of system tested.

1.7 QUALITY ASSURANCE

- A. All underground fire protection sprinkler piping shall be installed by a Washington State Licensed Fire Protection Sprinkler Contractor carrying a Level III or Level "U" license.
- B. Installer Qualifications: Installation of entire system shall be accomplished by a manufacturer of approved sprinkler equipment, his representative or licensee, who is now and has been engaged in the installation of automatic sprinkler systems for the past seven years.
- C. Hydraulic calculations and sprinkler system design shall be done under direct supervision of a NICET level 3 sprinkler designer with experience in this profession.

1.8 DELIVERY AND STORAGE

- A. All equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust or other contaminants.

1.9 WARRANTY OF MATERIAL AND WORKMANSHIP

- A. Guarantee all work included in this section for a period of one year after date of Certificate of Substantial Completion. During that period, all defects due to faulty materials or workmanship and damage to other work, resulting thereof or the correction of same, shall be remedied at the Contractor's expense. The guarantee shall be submitted in the form called for in the "Project Close-out."

PART 2 - PRODUCTS

2.1 PIPING

- A. Allied, Wheatland, Sawhill, Textube, USX, Frontier, Maruichi American, Cyclops, LaCleadt, or equal.
- B. Piping: Black steel, Schedule 40 or Schedule 10, ASTM A-53-78 or ASTM A-135-73A, Type E, Grade A or Grade B.

2.2 FITTINGS

- A. Schedule 40, Black Steel, Pipe: Screwed joints, ANSI B2.1, welded joints ANSI B31.10, B31.10a, B31.10b, mechanical grooved couplings joined by an UL and FM approved combination of bolted couplings, gaskets and grooves. Grooves may be rolled or cut and be dimensionally compatible with the coupling.
- B. Schedule 10, Black Steel: Welded joints, ANSI B31.10, B31.10b, and by UL and FM approved mechanical couplings. Couplings may be of the bolted rolled grooved type or the mechanical locking type. Grooves for the rolled grooved type shall be rolled only.
- C. Cast Iron Screwed: ANSI B16.4.
- D. Cast Iron Flanged: ANSI B16.1, or AWWA C 207.
- E. Saddle type mechanical tees shall be acceptable for concealed pipe only.
- F. Plain-end fittings/joints shall not be acceptable.
- G. Mechanical pipe coupling housings shall be of malleable iron conforming to ASTM A 47, Grade 32510 or ductile iron conforming to ASTM A 536, Grade 65-45-12. Coupling nuts and bolts shall be of steel and conform to ASTM A 183.
- H. Flange Gaskets: Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR).
- I. Squarehead Bolts and Heavy Hexagon Nuts: ASME B18.2.1 and ASME B18.2.2, and ASTM A 307, ASTM A 575, or ASTM A 576.

2.3 ABOVE GRADE WALL/FLOOR PENETRATIONS

- A. Pipe passing through rated walls shall be filled to the manufacturer's recommended thickness with fire resistant caulk.
 - 3. Manufacturer: 3M Bio-Fire , FIPRO Firestop Systems A/D Firebarrier, or listed equal.
 - 4. Escutcheons shall be chrome plastic, either one piece or split pattern, held in place by internal spring tension or set-screw.

2.4 SPRINKLERS

- A. Quick response sprinklers shall be standard type except as noted below. The maximum distance from the deflector to finished ceiling shall be 50 mm (2 in.) for pendent sprinklers. Pendent sprinklers in finished areas shall be provided with semi-recessed adjustable screwed escutcheons and installed within the center one-third of their adjustment. The sprinkler shall be installed in the flush position with the element exposed below the ceiling line. At the specified locations, provide the following type of sprinklers. All sprinklers except "institutional" type sprinklers shall be FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval, and the following:

LOCATION	TYPE
Mechanical Equipment Rooms, Electrical & Electrical Switch Gear Rooms	Quick Response, Upright or Telephone Closets, Transformer Vaults Pendent Brass [93 °C (200 °F)]
Elevator Shafts, Dumbwaiter Shafts, Elevator Machine Rooms, Elevator Pits	Standard Upright or Sidewall Brass [93 °C (200 °F)]
Gravity Type Linen & Trash Chutes	Standard Upright or Pendent Brass [66-74 °C (150-165 °F)]
Warehouse [Storage under 3600 mm (12 ft.)]	Quick Response, Pendent or Upright, Brass [77-74 °C (150-165 °F)]
Warehouse [Storage over 3600 mm (12 ft.)]	See NFPA 13
Cold rooms, Freezers, Controlled Temperature Rooms and Unheated Areas	Standard Pendent, Dry Type [66-74 °C (150-165 °F)]
Kitchen Hoods, Exhaust Ducts & Duct Collars	Standard Pendent or Upright (Extra High Temperature [163-191 °C (325-375 °F.)])
Generator Rooms	Standard Pendent or Upright [141 °C (286 °F)]
Mental Health and Behavioral Unit: Nursing Bedroom, Toilets and all areas with plaster/ dry wall ceilings within the area	Institutional Quick Response; Chrome plated with 85 lb. breakaway, Pendent, Horizontal Sidewall [66-74 °C (150-165 °F)]
Patient Sleeping, Patient Bathrooms, and Corridors within a Patient Ward	Residential, Quick Response, Recessed Pendent, Chrome Plated, [66-74 °C (150-165 °F)]
All Patient Treatment, Elevator Lobbies and Corridors	Quick Response, Recessed Pendent, Chrome Plated [66-74 °C [150-165 °F]]
Operating Rooms, Radiology Rooms, Nuclear Medicine Rooms	Quick Response, Recessed Pendent, Chrome Plated, Sidewall [66-74 °C (150-165 °F)]
All Areas Not Listed Above	Quick Response, Recessed Pendent, Sidewall, Chrome Plated [66-74 °C (150-165 °F)]

- B. Do not use quick response sprinklers in the same sprinkler zone with other sprinklers types. In sprinklered light hazard patient zones that are expanded into fully sprinklered zones, revise the existing system to contain quick response sprinklers.
- C. Sprinklers to be installed as per NFPA 13.

2.5 BELOW GRADE WALL/FLOOR PENETRATIONS

- A. Provide a positive hydrostatic sealing device rated at a minimum of 20 PSIG differential.
 - 5. Device shall be removable from the sleeve without damage to device.
 - 6. Manufacturers: Link Seal, or equal.

2.6 PIPING, HANGERS, INSERTS AND SUPPORT

- A. All piping shall be supported and braced from the structure in accordance with NFPA #13.

2.7 INTERIOR CONTROL VALVES

1. Control valves shall be UL listed and/or FM approved for installation in fire protection sprinkler systems.

2.8 INTERIOR AUXILIARY/UTILITY VALVES

- A. Selection based on United Brass Works, Grinnell, Kennedy, Victaulic, or listed and approved equal. All valves must be submitted and meet ratings as described below.
- B. Combination Inspection Test & Drain Valves:
 2. UL-04 and FM, bronze body, with chrome plated bronze ball, brass stem, steel handle, Teflon seat and site glass. Provide valve with three position indicator plate (off, test and drain), 1/4-inch tapping for pressure gauge and various sized orifice inserts to simulate flow through sprinkler heads.
 3. Manufacturer: Victaulic or listed and approved equal.
7. Globe and Angle Valves:
 1. UL-04, bronze body, replaceable non-metallic disc, slip-on disc holder, screwed ends, union bonnet, ventilated aluminum hand wheel and 300 lbs. WOG.
 2. Manufacturer: United Brass Works, Inc., Models 45S and 46S, Central, Models F15 and F16, or listed equal.
8. Ball Valves:
 1. The brass nut, stem gland screw, stem, and ball disc shall conform to ASTM B-16-C36000. The handle shall be steel conforming to ASTM A-283-D. The forged brass body and end plug shall conform to ASTM B-124-C37700. The teflon stem packing, thrust packing and ball disc packing shall be commercial grade PTFE.
 2. Manufacturer: United Brass Works, or listed equal.
9. Gauge Isolation Valves:
 1. Bronze body with screwed bonnet and screwed 1/8" or 1/4" ends and 400 lbs. WOG.
 2. Manufacturer: United Brass Works, Inc., Model 76 or equal.

2.9 SWING CHECK VALVE

- A. Under 3 inch size valves shall meet the requirements of MSS SP-80. All valves shall be UL-04 listed.
- B. Valves 2-1/2 inch and greater:
 3. Shall be iron body, bronze mounted.
 4. All valves shall be listed in UL-04 or FM-P7825 Approval Guide and shall be straightway type, suitable for vertical or horizontal installation with end connections as required to mate with piping in which the valve must be installed.
 5. Manufacturer: Shotgun-90 (for riser applications), Grinnell, Victaulic, Viking or listed equal.
10. Valves 2 inches and smaller:
 1. The valve shall incorporate a bronze body, bronze cap and brass rod disc holder conforming to ASTM B-62. Brass rod hinge pin, brass rod

hinge pin plug, brass plate disc washer and brass rod disc nut shall conform to ASTM B-16. The seat disc shall be commercial grade NBR.

2. Manufacturer: Shotgun 90 (riser applications), United Brass Works, or listed equal.

2.10 AUTOMATIC BALL DRIPS

- A. UL-04, 1/2" cast brass inline automatic ball drip with both ends threaded with iron pipe threads. Pipe drain to spill through building wall over floor drain over mop sink or as approved.
- B. Manufacturer: United Brass Works, Inc., Model 235 or equal.

2.11 GAUGES

- A. Sprinkler gauge, 3-1/2" dial, fitted with gauge valve shut-off in accordance with UL-04.
- B. Manufacturer: Ashcroft, and listed equal.

2.12 SPRINKLER ALARMING EQUIPMENT

1. Tamper Switches: Potter #OSYSU-A or PCVS series, or equal by System Sensor.
- C. Flow Switches: Potter #VSR-F, or equal by System Sensor.
- D. Pressure Alarm Switches: Potter #PS10-2A, or equal by System Sensor.
- E. Pressure Low Air Supervisory Switches: Potter #PS40-1A, or equal by system Sensor.

2.13 DRY PIPE VALVE

1. Provide dry pipe valve, complete with basic trimming and air maintenance device, controls sized as indicated. Accelerator required if system is 500 gallons, or does not make 60 second test.
- F. Manufacturer: GEM, Reliable, Viking, or listed equal.

2.14 AIR COMPRESSOR

1. Provide UL listed air compressor sized for volume of system per NFPA requirements. Compressor to be hard wired, have a minimum 17 gallon tank, and be mounted to floor.
- G. Manufacturer: GAST, Jenny, General Air Products, or listed equal.

2.15 MISCELLANEOUS EQUIPMENT

- A. Access Panels:
 1. Access panels shall be suited for installation in dry wall, masonry, tile, wood, or other wall surfaces.
 2. The door shall have rounded safety corners.
 3. The door and frame shall be fabricated from 16 gage, galvanized steel and shall have a factory prime coat finish suitable for painting.
 4. The frame shall be one piece construction, 1" wide and shall provide concealment of the rough wall opening. The frame shall have no miters or welds on the face. The wall frame shall be provided with 1/4" mounting holes for fastening within the furred space.

5. Doors less than 24" shall be provided with a concealed pivoting rod hinge. Doors 24" or larger shall be provided with a continuous piano hinge.
6. The latch shall be screwdriver operated.
7. Manufacturer: ELMDOR Manufacturing Co. or approved equal.
2. Valve Identification Signs:
 1. Signs shall be constructed of metal. Lettering to be white on a red background.
 2. Hydraulic Information Signs: Provide punched metal signs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine work surfaces and substrates to receive work of this Section and report any defects which may affect work of this Section.
- B. Confirm compatibility of surfaces to receive materials as specified within this Section.
- C. Beginning of installation means acceptance of existing surfaces and substrates.

3.2 GENERAL INSTALLATION

- A. Pipe shall be fabricated at risk of Contractor if not all approvals have been obtained.
- B. Welding for flame cutting shall not be performed on or within the building without prior written approval of the Owners Representative.
- C. The Contractor shall meet all requirements for interruption of existing services, and for Fire Department stand-by. This work shall be coordinated with the Architect and/or Owner.
- D. Unless otherwise indicated or specified, all materials and equipment shall be installed in accordance with the manufacturer's recommendations and in accordance with NFPA 13.
- E. Cutting structural members for passage of pipes or for pipe hanger fastenings will not be permitted unless the Contractor has been granted prior approval by the Architect and Engineer.
- F. Belts, pulleys, chains, gears, couplings, projecting set screws, keys, and other rotating parts, shall be so located as to be fully enclosed or guarded to prevent a person coming in contact therewith.
- G. Contractor shall get approval for any exposed pipe by design team prior to installation

3.3 PIPING

- A. Piping shall be installed as indicated and specified. Pipe shall be cut accurately to measurement established at the building by the Contractor, and shall be worked into place without springing or forcing and out of the way of all doors, windows and other openings. Pipes shall be installed so that it may expand and contract freely without damage to any other work or to itself. Piping in finished portion of the building shall be installed in such a manner as to require a minimum of furring. Pipe openings shall be closed with caps and/or plugged after installation to prevent entrance of foreign materials before final connection. The contract documents do not attempt to show all details of the piping. No extra payments will be allowed when obstructions in the work of others or work under this contract requires offsets in piping.
- B. All pipe sizes shall be determined by hydraulic calculation(s) with the exception of underground piping which is by others. Should local ordinances or codes be construed

as requiring larger sizes in any instance, this shall be taken care of by the Contractor without additional cost to the Owner and shall be called to the attention of the Architect or Owner's Representative.

- C. All piping shall be arranged to provide the maximum amount of access so as to provide for future maintenance.

3.4 JOINTS

- A. Joints shall conform to NFPA 13. Shop welded joints will be permitted. Flanged joints or mechanical grooved couplings shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Mechanical couplings and fittings shall be from the same manufacturer.
- B. Threaded joints with Teflon.
- C. Flanged joints shall be faced true, provided with gaskets and made square and tight.
- D. Mechanical grooved pipe joints shall conform to AWWA C606. Joints shall be made using a UL-04 listed or FM-P7825 approved combination of fittings, gaskets, and grooves. Cut or rolled pipe grooves shall be dimensionally compatible with the fittings.
- E. Mechanical pipe couplings shall be of the bolted type and shall consist of a housing fabricated in one or more parts, a synthetic rubber gasket, and nuts and bolts to secure the unit together.
- F. Gaskets shall be of molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000.

3.5 GROOVE COUPLINGS

- A. Provide listed flexible and rigid groove couplings on mains as required by NFPA #13 couplings on sprinkler mains per NFPA regulations.

3.6 WALL/FLOOR/CEILING ESCUTCHEONS

- A. Escutcheons shall be provided at all finished surfaces where exposed piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.7 PIPING, HANGERS, INSERTS AND SUPPORT

- A. General: Provide hangers, brackets, supports, anchors, and related appurtenances, as required, to support all piping and equipment provided under this section. Piping and equipment supports shall conform to NFPA Pamphlet No. 13.
- B. Floor Supports: Provide where required, necessary floor supports for piping and equipment. Supports shall be fabricated from structural members or shall be masonry piers.
- C. Hanging of pipes from ductwork is strictly prohibited.

3.8 PIPING MAINTENANCE AND PROTECTION REQUIREMENTS

- A. Flushing:
 - 3. Flushing arrangements shall be provided per NFPA 13 in accessible locations.
 - 4. Disinfection/Chlorination: Not required.

3.9 DRAINS AND DRIPS

- A. All piping shall drain back to the main riser.

- B. Install auxiliary drains at all low points in system. Trapped sections of piping shall be equipped with drains as required by NFPA #13. Sections of trapped piping not exceeding five gallons in volume may be terminated with a minimum 3/4" plug or nipple and cap. Sections of trapped piping exceeding five gallons shall be piped to a location suitable to the architect and equipped with a 1" ball or globe valve. Any drain not discharging to a suitable receptacle shall terminate with a male garden hose adapter with hose cap and gasket.

3.10 TESTS AND APPROVALS OF SPRINKLER SYSTEM

- A. Hydrostatic Test: Test pipe of sprinkler systems with not less than 200 PSIG pressure for 2 hours in presence of Architect, Engineer, Owner, or authorized representatives of Fire Department. Provide approval certificates. Give ample advance notice of times at which tests are to be carried out, and, if work does not satisfactorily pass these, make all necessary corrections and repeat tests. Provide equipment, material, and labor necessary for inspection and tests. Carry out all tests prior to furring in or otherwise concealing pipe. No exceptions will be made. Preliminary tests may be done with compressed air.

3.11 SPRINKLER HEAD LOCATIONS AND SYSTEM ARRANGEMENT

- A. Provide full sprinkler coverage of the area, including additional heads necessary to provide an adequate pattern of water discharge adjacent to partitions and around and beneath duct(s), doors, or other obstructions. Provide automatic sprinkler protection below ductwork 4'-0" or greater in width in accordance with NFPA 13.
- B. Exact location of heads shall be carefully coordinated with other ceiling elements for a symmetrical pattern. Sprinkler heads shall not be located closer than 1' from lighting fixtures, diffusers, speakers or similar devices or obstructions. Contractor shall obtain coordination among the trades so as to avoid any interference with the potential effectiveness.
- C. Provide head guards for all sprinklers located with 6'-8" of walking surfaces.
- D. Locate head boxes on the wall adjacent to system sprinkler risers.

3.12 SPARE SPRINKLERS

- 1. The Contractor shall furnish spare automatic sprinklers in accordance with the requirements of NFPA 13 for stock of extra sprinklers. The sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. The Contractor shall furnish no less than two special sprinkler head wrenches, or at least one head wrench for each sprinkler head box, whichever is greater.
- 2. Spare sprinklers and head wrenches shall be located in head boxes. Locate boxes as specified above.

3.13 ACCESS PANELS

- 1. Any sprinkler valving or equipment which is located in inaccessible areas shall be provided with an access panel by this Contractor. The panel shall be large enough to readily pass all equipment/manpower through to make repairs. The panel location is subject to approval by the Architect. Panel shall be rated the same as wall or ceiling in which it is located. Provide 6" x 6" red lettered place card made of metal. Attach to ceiling tile below the concealed device.

3.14 PAINTING

- E. Painting of piping, where required, shall be by Section 09900 contractor. The sprinkler contractor shall leave all piping reasonably clean and free from excess grease, oil, dirt, and rust. The painting contractor shall be responsible for all aspects of paint preparation, including covering of heads and removal of coverings when painting is completed. The sprinkler contractor shall remind the General and Painting contractors prior to the beginning of painting work, in writing, that painting sprinkler heads is forbidden and that all painted heads will be replaced at painter's expense. Cleaning of painted heads is not acceptable."

IDENTIFICATION

1. Piping Identification: Provide adhesive stickers every 40 feet on all cross-mains, bulk mains and pipes sized 2" or greater. Sticker to read "Fire Sprinkler."
2. Valve Identification: Signs: Provide identification sign (enamel on metal) to all valves in accordance with NFPA 13. Signs shall indicate purpose of valve and zone number or name.
3. Hydraulic Information Signs: Provide in accordance with NFPA 13. Locate on sprinkler riser. Sign shall indicate the system number/ name, design density, design area, hose stream demand and overall system demand.
4. Access Panel Signs: Provide access panel signs where access panels are used to conceal sprinkler system valving. Signs to be as specified above for "Valve Identification" but shall be pop-riveted to the access panel.

END OF SECTION 21 10 00

DIVISION 22– PLUMBING

Section 22 05 13	Common Motor Requirements for Plumbing Equipment	3
Section 22 05 17	Sleeves and Sleeve Seals for Plumbing Piping.....	5
Section 22 05 18	Escutcheons for Plumbing Piping	2
Section 22 05 23	General-Duty Valves for Plumbing Piping	10
Section 22 05 29	Hangers and Supports for Plumbing Piping and Equipment	12
Section 22 05 53	Painting and Identification for Plumbing Piping and Equipment	5
Section 22 07 19	Plumbing Piping Insulation	21
Section 22 08 00	Plumbing Commissioning	2
Section 22 11 16	Domestic Water Piping	13
Section 22 11 19	Domestic Water Piping Specialties.....	12
Section 22 11 23	Domestic Water Pumps	4
Section 22 13 16	Sanitary Waste and Vent Piping	13
Section 22 13 19	Sanitary Waste Piping Specialties	10
Section 22 33 00	Electric, Domestic-Water Heaters.....	6
Section 22 34 00	Fuel-Fired, Domestic-Water Heaters	6
Section 22 42 13.13	Commercial Water Closets	4
Section 22 42 13.16	Commercial Urinals.....	4
Section 22 42 16.13	Commercial Lavatories	5
Section 22 47 16	Commercial Urinals.....	3

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.

3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: electronically commutated motor with speed controller.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 22 05 17 - 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 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. 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. 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. 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. 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 or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- 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. 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, 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 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 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 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 079200 "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 078413 "Penetration Firestopping."

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 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 076200 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches 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 078413 "Penetration Firestopping."

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 water stop 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: Galvanized-steel wall sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
- b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 22 05 18 - 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.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed 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 hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed 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

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. Brass ball valves.
 - 2. Bronze ball valves.
- B. Related Sections:
 - 1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 2. Section 221116 "Domestic Water Piping" 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. Valves in Insulated Piping: With 2-inch 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.

E. 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.

- F. 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, 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.
 - 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, 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.
 - 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, 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.
- 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, 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.
- 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. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

- 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. 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. Red-White Valve Corporation.

- 2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- 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.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

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. 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. Red-White Valve Corporation.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - 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.

C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

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. 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. Red-White Valve Corporation.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - 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.

D. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

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. 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. Red-White Valve Corporation.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - 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.

2.4 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - 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.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - 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.

C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - 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.

D. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.

- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Red-White Valve Corporation.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- 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.

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 valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches 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, ball, or butterfly valves.
 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.
 - c. NPS 2-1/2 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 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: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 125, bronze disc.
 3. Ball Valves: Two piece, regular port, bronze with bronze trim.
 4. Bronze Swing Check Valves: Class 125, bronze disc.
 5. Bronze Gate Valves: Class 125, NRS or RS.

6. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: 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 disc.
4. Iron, Grooved-End Butterfly Valves: 175 CWP.
5. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.
9. Iron, Plate-Type Check Valves: Class 125; dual plate; metal seat.
10. Iron Gate Valves: Class 125, NRS or OS&Y.
11. Iron Globe Valves: Class 125.

END OF SECTION 220523

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. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. 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: Pregalvanized 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.
- 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.

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 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. 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.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Electroplated zinc.
8. Paint Coating: Epoxy.

B. Non-MFMA Manufacturer Metal Framing Systems:

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. 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.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc or Paint.

2.4 THERMAL-HANGER SHIELD INSERTS

- 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. 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.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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, 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.

2.6 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 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.
 - 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.

2.7 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.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 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, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 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 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 077200 "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 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 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 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: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 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.

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.
- B. 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 stainless-steel 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 noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, 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 noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 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, 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, 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 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, 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, 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 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 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 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.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 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 for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F 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 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.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 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.
 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.

3.7 END OF SECTION 220529

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. Valve tags.
 - 5. 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: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch 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.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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 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, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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 cover full 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 high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch 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 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.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 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. 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 1. Domestic Water Piping:
 - a. Background Color: Green.
 - 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: 2 inches, round.
 - b. Hot Water: 2 inches, round.
2. Valve-Tag Color:
 - a. Cold Water: Natural or Green.
 - b. Hot Water: Natural or Green.
3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.

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

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. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

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. 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.

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. 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 220529 "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. 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, 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.
- G. 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, 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.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 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. 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 Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 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. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 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. 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, 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.
 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. 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aero seal.

- 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, 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.
- 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. 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, 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, 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, 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 at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 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, 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 at 35-mil dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F.
 - 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, 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 at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 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, 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 at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 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, 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 pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, 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.
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, 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.
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, 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.
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. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 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. 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. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for 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. 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..
 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. 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, 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: White.
 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, 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, 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-thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
- 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.
- b. Material, finish, and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
- 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-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, 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.

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, 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.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch 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, 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.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch 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, 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.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
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. 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.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

- 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. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
- 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
- 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

- 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. C & F Wire.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

- 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. 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.
- 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,:

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. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. 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-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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 4 inches 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 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 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.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Seal penetrations with flashing sealant 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 078413 "Penetration Firestopping" 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 078413 "Penetration Firestopping."

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 valves, unions, and equipment requiring removal of insulation for maintenance. 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 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 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.

3.7 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 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, 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.

3.8 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 overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-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 laps at longitudinal seams and 3-inch-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 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 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 o.c. and at end joints.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

3.13 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.

D. Piping, Exposed:

1. PVC: 20 mils thick.

END OF SECTION 220719

SECTION 22 08 00 PLUMBING COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

- A. The purpose of this section is to describe the commissioning process specific for those sections found in Division 22.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. General Responsibilities: The Contractor's commissioning responsibilities applicable to the plumbing contractor are as follows:
 - 1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - 2. Attend a commissioning kick-off meeting and other meetings necessary to facilitate the Commissioning process.
 - 3. Contractors shall assist in clarifying the installation, operation, maintenance, and control of commissioned equipment if requested by the Commissioning Authority.
- B. Coordination
 - 1. Refer to Section 01 91 13 for a listing of all sections where commissioning requirements are found, for systems to be commissioned and for Pre-verification testing requirements.

1.3 SUBMITTALS

- A. General Submittals: Contractor shall provide to the Commissioning Authority, through established channels, normal cut sheets, shop drawing submittals, and manufacturer's installation and start-up checklists, for all commissioned equipment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation Checklists: The Contractor shall complete the checklist(s) provided with and using the Facility Grid app.
 - 1. The completion of these checklists does not limit the Contractor's responsibilities for quality control and scheduling as indicated elsewhere in the documents, nor does this checklist include all submittal, inspection, or quality assurance requirements for the work of this Section.

3.2 CLOSEOUT ACTIVITIES

- A. Pre-Verification Testing (PVT): The Contractor will perform the Pre-verification tests as provided with the Facility Grid app. When all pre-verification testing has been completed, the CA will schedule Functional Performance testing and substantial completion may be issued.
- B. Functional Performance Testing (FPT): The CA shall verify that the PVT's were done and complete by running the FPT's in the Facility Grid app.
- C. Operation and Maintenance Manuals: The approved complete manuals must be on site prior to training.
- D. Training: The Owner personnel shall be trained on procedures related to the list in 1.1A above.

3.3 DOCUMENTS REQUIRED

- A. The General Contractor will provide the following documentation before Final Acceptance:
 - 1. Completed Inspection Forms with approval signatures of all Authority Having Jurisdiction.
 - 2. Approval Signature of Engineer of Record
 - 3. Training Attendance Sheets with Agenda

END OF SECTION

SECTION 221116 - DOMESTIC WATER PIPING

1.1 GENERAL

1.2 RELATED DOCUMENTS

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

1.3 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 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.4 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.5 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

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 and ASTM B 88, Type M water tube, drawn temper.

- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L 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-Tube, Extruded-Tee Connections:
 - 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. T-Drill Industries Inc.
 - 2. Description: Tee formed in copper tube according to ASTM F 2014.
- H. Appurtenances for Grooved-End Copper Tubing:
 - 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. Anvil International.
 - b. Shurjoint Piping Products.
 - c. Victaulic Company.
 - 2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - 3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig.

2.3 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, 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; Tyco Fire Products LP.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 - 2. 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.
 - 3. 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 and Smaller: 600 psig.
 - 2) NPS 10 and NPS 12: 400 psig.
 - 3) NPS 14 to NPS 24: 250 psig.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.5 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - 2. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
 - 2. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.
 - 2. Standard: ASSE 1079.
 - 3. Pressure Rating: 125 psig minimum at 180 deg F.
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 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. 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.
 - 2. Standard: ASSE 1079.
 - 3. Factory-fabricated, bolted, companion-flange assembly.
 - 4. Pressure Rating: 125 psig minimum at 180 deg F.
 - 5. 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, 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. Nonconducting materials for field assembly of companion flanges.
 - 3. Pressure Rating: 150 psig.

4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 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 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install domestic water piping level without pitch and plumb.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. 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.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install PEX piping with loop at each change of direction of more than 90 degrees.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 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," "Braze 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. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. 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.
- G. 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.
- H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut or 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.
- I. 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.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 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 and Smaller: Fitting-type coupling.
 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "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 and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- G. Install supports for vertical steel piping every 15 feet.
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 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 and larger.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.8 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 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.

3.9 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.

3.10 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 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 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.

3.11 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 and smaller, shall be the following:
1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; 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.

3.12 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 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 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

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. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Wall hydrants.
8. Post hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Air vents.
12. Trap-seal primer valves.
13. Flexible connectors.

- B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
4. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

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.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; a division of Watts Water Technologies, Inc.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome or nickel plated in finished area, Rough bronze in mechanical rooms and unfinished areas.

- B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

- h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated in finished area, Rough bronze in mechanical rooms and unfinished areas.

C. Pressure Vacuum Breakers:

- 1. Manufacturers: Subject to compliance with requirements, provide products 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. Toro Company (The); Irrigation Div.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
- 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products 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.
- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
- 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
- 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

- b. Valves NPS 2-1/2 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.

B. Hose-Connection Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
- 2. Standard: ASSE 1052.
- 3. Operation: Up to 10-foot head of water back pressure.
- 4. Inlet Size: NPS 1/2 or NPS 3/4.
- 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
- 6. Capacity: At least 3-gpm flow.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products 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.
- 2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
- 3. Body: bronze.
- 4. Size: Same as connected piping, but not larger than NPS 2.
- 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a division of Watts Water Technologies, Inc.

- h. Symmons Industries, Inc.
 - i. TACO Incorporated.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - l. Sloan Valve Company
- 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded union inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Valve Finish: Chrome plated in finished areas, and Rough bronze in mechanical rooms and unfinished areas.

B. Individual-Fixture, Water Tempering Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a division of Watts Water Technologies, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - i. Sloan Valve Company
- 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Body: Bronze body with corrosion-resistant interior components.
- 5. Temperature Control: Adjustable.
- 6. Inlets and Outlet: Threaded.
- 7. Finish: Rough or chrome-plated bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 2. Body: Bronze for NPS 2 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 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.125 inch.
 - c. Strainers NPS 5 and Larger: 0.25 inch.

6. Drain: Pipe plug.

2.8 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze or Chrome or nickel plated as scheduled.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASME A112.21.3M for concealed or exposed-outlet as scheduled, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze or Chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

11. Nozzle and Wall-Plate Finish: Polished nickel bronze or Rough bronze as scheduled.
12. Operating Keys(s): Two with each wall hydrant.

2.10 POST HYDRANTS

A. Freeze-Resistant Sanitary Yard Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Prier Products, Inc.
 - c. Simmons Manufacturing Co.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1057, Type 5 for nondraining hydrants.
3. Operation: Wheel handle.
4. Head: Copper alloy, with pail hook.
5. Inlet: NPS 3/4-inch threaded inlet and inlet nozzle, galvanized-steel riser, and venturi.
6. Canister: Zinc-plated steel with atmospheric-vent device.
7. Vacuum Breaker:
 - a. Removable hose-connection backflow preventer complying with ASSE 1052.
 - b. Garden-hose thread complying with ASME B1.20.7 on outlet for field installation.

2.11 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 minimum CWP.
3. Size: NPS 3/4.
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.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 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 minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Drainage-Type, Trap-Seal Primer Device:
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:
 2. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 4. Size: NPS 1-1/4 minimum.
 5. Material: Chrome-plated, cast brass.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.
 4. Flex-Weld Incorporated.
 5. Hyspan Precision Products, Inc.
 6. Mercer Gasket & Shim, Inc.
 7. Metraflex, Inc.
 8. Proco Products, Inc.
 9. TOZEN Corporation.
 10. Unaflex.Universal Metal Hose; a Hyspan company.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

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 fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "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 fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- J. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. 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.
- 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 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power 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 220553 "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

3.6 Set field-adjustable pressure set points of water pressure-reducing valves.

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 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.

1.7 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.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Corporation.
 - 3. Grundfos Pumps Corp.
 - 4. TACO Incorporated.
 - 5. WILO USA LLC - WILO Canada Inc.
 - 6. XYLEM inc.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Casing: Bronze, with threaded or companion-flange connections.
 - 3. Impeller: Plastic.
 - 4. Motor: Single speed, unless otherwise indicated.
- D. Capacities and Characteristics:
 - a. See schedules on drawings.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install horizontally mounted, in-line, separately coupled and close-coupled centrifugal pumps with shaft(s) horizontal.
- D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.
- E. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.
 - 1. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- F. Install pressure switches in water supply piping.
- G. Install thermostats in hot-water return piping.
- H. Install timers.
- I. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
 - b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - c. Vertically mounted, in-line, close-coupled centrifugal pumps.
 - d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
 - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
 - 3. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tapings where provided or install pressure-gage connectors in suction and discharge piping around

pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- D. Connect pressure switches, thermostats, time-delay relays, and timers to pumps that they control.
- E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

3.6 Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.7 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

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. Below grade sanitary piping: Cast iron as described in products
Above grade sanitary piping: PVC or ABS as described in products
- B. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

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.
 - 2. Waste, Force-Main Piping: 100 psig.
- 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. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. 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 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 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. Solvent 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 ABS PIPE AND FITTINGS

- A. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- C. 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."

2.5 PVC PIPE AND FITTINGS

- A. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. 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."
- D. 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."

2.6 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, 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, 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, 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.
- 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, 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 minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - 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) 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 minimum at 180 deg F.
 - 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, 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.
 - 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, 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 at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.7 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 or high-density, cross-laminated polyethylene film of 0.004-inch 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 312000 "Earth Moving."

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 220548 "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 and smaller; 2 percent downward in direction of flow for piping NPS 4 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 aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Install underground ABS and PVC piping according to ASTM D 2321.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- Q. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "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 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "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. 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.
- E. 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.
- F. 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.
- G. 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: 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 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 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 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet 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 of each fitting 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 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: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

- I. Install supports for vertical copper tubing every 10 feet.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 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. 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 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 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. 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. 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.

3.9 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.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 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 and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 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; heavy-duty hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 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; heavy-duty hubless-piping couplings; and coupled joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 3. Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; coupled joints.
 3. Cellular-core PVC pipe; PVC socket fittings; and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

3.11 END OF SECTION 221316

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. Roof flashing assemblies.
 - 4. Through-penetration firestop assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. 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. 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 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Josam Company.

- 3. Standard: ASME A112.36.2M for cast iron, and 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 or Stainless-steel tee with side cleanout as required to match connected piping.

6. Closure: Countersunk or raised-head, brass 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Josam Company.

4. Standard: ASME A112.36.2M for adjustable housing cleanout.
5. Size: Same as connected branch.
6. Type: Adjustable housing.
7. Body or Ferrule: Cast iron.
8. Clamping Device: Not required.
9. Outlet Connection: Inside cask, Spigot, or Threaded.
10. Closure: Brass plug with tapered threads.
11. Adjustable Housing Material: Cast iron with threads.
12. Frame and Cover Material and Finish: Polished bronze.
13. Top Loading Classification: Heavy Duty.
14. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
15. Standard: ASME A112.3.1.
16. Size: Same as connected branch.
17. Housing: Stainless steel.
18. Closure: Stainless steel with seal.
19. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

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. 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.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:

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. 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.
2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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.

- 2. Standard: ASME A112.6.3.
- 3. Pattern: As scheduled.
- 4. Body Material: Gray iron.
- 5. Seepage Flange: Required.
- 6. Anchor Flange: Required.
- 7. Clamping Device: Required.
- 8. Coating on Interior and Exposed Exterior Surfaces: As scheduled.
- 9. Sediment Bucket: As scheduled.
- 10. Top or Strainer Material: As Scheduled.
- 11. Top of Body and Strainer Finish: As scheduled.
- 12. Top Shape: Round or Square as scheduled.
- 13. Top Loading Classification: Medium Duty unless noted otherwise.
- 14. Funnel: As scheduled.
- 15. Trap Features: Trap-seal primer valve drain connection.

B. Stainless-Steel Floor Drains:

- 1. ASME A112.3.1, Stainless-Steel Floor Drains:
 - a. Manufacturers: Subject to compliance with requirements, into the Work include, but are not limited to, the following:
 - 1) Josam Company.
- 2. ASME A112.6.3, Stainless-Steel Floor Drains:
 - 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) Josam Company.
 - 2) Smith, Jay R. Mfg. Co.
 - 3) Watts Drainage Products.
 - 4) Zurn Plumbing Products Group.
- 3. Standard: ASME A112.3.1.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies

- 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. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- 2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. ProSet Systems Inc.
- 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 3. Size: Same as connected soil, waste, or vent stack.
- 4. 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.
- 5. 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.
- 6. Special Coating: Corrosion resistant on interior of fittings.

B. Floor-Drain, Trap-Seal Primer Fittings

- 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. 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 inches 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.

E. 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.

F. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. 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.

2.5 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., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch 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..
2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil 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.

2.6 MOTORS

A. General requirements for motors are specified in Section 220513 "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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. 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 or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch 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.
- E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- G. Assemble open drain fittings and install with top of hub 1 inch above floor.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
1. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- Q. Install wood-blocking reinforcement for wall-mounting-type specialties.
- R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "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. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power 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., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch 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, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches 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 076200 "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 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- 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.

3.5 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 221319

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Commercial, electric, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.07 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. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.08 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Three years.
 - b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.01 COMMERCIAL, ELECTRIC, domestic-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Bradford White Corporation.
 - b. Lochinvar Corporation.
 - c. Precision Boilers, Inc.
 - d. PVI Industries, LLC.

- e. Rheem Manufacturing Company.
 - f. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - g. State Industries.
- 2. Standard: UL 1453.
 - 3. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Compression Tanks:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMTROL Inc.
 - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - c. State Industries.
 - d. Taco, Inc.
 - 2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - 3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

- b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- G. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.03 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 4000 "Quality Requirements" for retesting and reinspecting requirements and Section 01 7300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete. Comply with requirements for concrete bases specified in Section 03 3000 "Cast-in-Place Concrete." or Section 03 3053 "Miscellaneous Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Place and secure anchorage devices. Use 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. Anchor domestic-water heaters to substrate.
- B. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - C. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
 - E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 0519 "Meters and Gages for Plumbing Piping."
 - F. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 0519 "Meters and Gages for Plumbing Piping."
 - G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
 - H. Fill electric, domestic-water heaters with water.
 - I. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 1116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

- A. 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.
 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 operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 4000 "Quality Requirements" for retesting and reinspecting requirements and Section 01 7300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.05 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION

SECTION 22 34 00 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, power-vent, gas-fired, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 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. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: One year(s).

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Power-Vent, Gas-Fired, Storage, Domestic-Water Heaters:
 - 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. American Water Heaters.
 - b. Bradford White Corporation.
 - c. Lochinvar Corporation.
 - d. Rheem Manufacturing Company.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
 - 2. Standard: ANSI Z21.10.3/CSA 4.3.
 - 3. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

- 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
- c. Lining: Vitreous enamel complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with power-vent, gas-fired, domestic-water heaters and natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
5. Special Requirements: NSF 5 construction.
6. Power-Vent System: Exhaust fan, interlocked with burner.

B. Capacity and Characteristics:

1. See schedules on drawings for capacity and characteristics.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

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. AMTROL Inc.
 - b. Flexcon Industries.
 - c. Honeywell International Inc.
 - d. Pentair Pump Group (The); Myers.
 - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - f. State Industries.
 - g. Taco, Inc.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
 - a. Working-Pressure Rating: 100 psig.

- b. Capacity Acceptable: 4 gal. minimum.
 - c. Air Precharge Pressure: 80 psig.
 - B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
 - C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - D. Heat-Trap Fittings: ASHRAE 90.2.
 - E. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- 2.3 SOURCE QUALITY CONTROL
- A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
 - B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
 - C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 "Quality Requirements" for retesting and reinspecting requirements and Division 01 "Execution" for requirements for correcting the Work.
 - D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 domestic-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.

- B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters according to NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 - 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Division 23 "Facility Natural-Gas Piping."
- D. Install commercial domestic-water heaters with seismic-restraint devices.
- E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 "Domestic Water Piping Specialties."
- G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Division 22 "Meters and Gages for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill domestic-water heaters with water.
- J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Division 22 "Domestic Water Piping."
- B. Comply with requirements for fuel-oil piping specified in Division 23 "Facility Fuel-Oil Piping."
- C. Comply with requirements for gas piping specified in Division 23 "Facility Natural-Gas Piping."
- D. Drawings indicate general arrangement of piping, fittings, and specialties.
- E. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 "Quality Requirements" for retesting and reinspecting requirements and Division 01 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 22 34 00

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

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. Water closets.
- 2. Toilet seats.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
- 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flush valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

- A. Water Closets: Floor mounted, bottom outlet, top spud.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. TOTO USA, INC.
 - h. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Standard, Child, or Handicapped/elderly, complying with ICC/ANSI A117.1 as scheduled.
 - f. Rim Contour: Elongated.
 - g. Water Consumption: 1.28 gal. or 1.6 gal. per flush as scheduled.
 - h. Spud Size and Location: NPS 1-1/2; top.
 - i. Color: [White] <Insert color>.
3. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.
4. Flushometer Valve: As scheduled.
5. Toilet Seat: As scheduled.

2.2 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Gerber Plumbing Fixtures LLC.
 - b. Sloan Valve Company.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Standard: ASSE 1037.
 3. Minimum Pressure Rating: 125 psig.
 4. Features: Include integral check stop and backflow-prevention device.
 5. Material: Brass body with corrosion-resistant components.
 6. Exposed Flushometer-Valve Finish: Chrome plated.
 7. Style: Exposed.
 8. Consumption: 1.28 gal. or 1.6 gal. per flush as scheduled.
 9. Minimum Inlet: NPS 1.
 10. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

- A. Toilet Seats:
 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. American Standard America.
 - b. Bemis Manufacturing Company.
 - c. Church Seats.
 - d. Kohler Co.
 - e. Olsonite Seat Co.
 - f. TOTO USA, INC.
 - g. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Standard: IAPMO/ANSI Z124.5.
 3. Material: Plastic.
 4. Type: Commercial (Standard).
 5. Shape: Elongated rim, open front.

6. Hinge: Self-sustaining.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Water-Closet Installation:
 1. Install level and plumb according to roughing-in drawings.
 2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
- B. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- C. Install toilet seats on water closets.
- D. Joint Sealing:
 1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
 2. Match sealant color to water-closet color.
 3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

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. Urinals.
 - 2. Flushometer valves.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

- A. Urinals: Wall hung, back outlet, washout, accessible.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. TOTO USA, INC.
 - h. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Washout with extended shields.
 - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
 - e. Spud Size and Location: NPS 3/4, top.
 - f. Outlet Size and Location: NPS 2, back.
 - g. Color: White.
3. Flushometer Valve: As scheduled.
4. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
 - b. Size: NPS 2.
5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Gerber Plumbing Fixtures LLC.
 - b. Sloan Valve Company.
 - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Consumption: 1.0 gal. per flush.
9. Minimum Inlet: NPS 3/4.
10. Minimum Outlet: NPS 3/4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

- 1. Install urinals level and plumb according to roughing-in drawings.
- 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
- 3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
- 4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
- 5. Install trap-seal liquid in waterless urinals.

B. Support Installation:

- 1. Install supports, affixed to building substrate, for wall-hung urinals.
- 2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
- 3. Use carriers without waste fitting for urinals with tubular waste piping.
- 4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

- 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
- 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

- 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
- 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- 3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

- 1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
- 2. Match sealant color to urinal color.
- 3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Lavatories.
 - 2. Faucets.
- B. Related Requirements:
 - 1. Section 224100 "Residential Plumbing Fixtures" for residential lavatories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory: Vitreous china, wall mounted, with back.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. Mansfield Plumbing Products LLC.
 - h. Peerless Pottery Sales, Inc.
 - i. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Nominal Size: Oval, 20 by 18 inches.
 - d. Faucet-Hole Location: Top.
 - e. Color: White.
 - f. Mounting Material: Chair carrier.
 3. Faucet: As scheduled
 4. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier

2.2 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory: Rectangular, self-rimming, vitreous china, counter mounted.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. Mansfield Plumbing Products LLC.
 - h. Peerless Pottery Sales, Inc.
 - i. Zurn Industries, LLC; Commercial Brass and Fixtures.
 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: Self-rimming for above-counter mounting.
 - c. Nominal Size: Oval, **20 by 18 inches** <Insert dimensions>.
 - d. Faucet-Hole Location: Top.
 - e. Color: White.
 - f. Mounting Material: Sealant.
 3. Faucet: As scheduled

2.3 MULTI STATION LAVATORIES

- A. Lavatory: 3 station 14 GA stainless steel wall mounted.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 2.
 - a. American Standard America.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C.
 - d. Ferguson Enterprises, Inc.; ProFlo Brand.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
 - g. Mansfield Plumbing Products LLC.
 - h. Peerless Pottery Sales, Inc.
 - i. Zurn Industries, LLC; Commercial Brass and Fixtures.
 - 3. Fixture:
 - a. Multi station ADA compliant
 - b. Nominal Size: 37" square
 - c. Color: Stainless steel
 - d. Mounting Material: Sealant.
 - 4. Faucet: integral push button at 0.5 gpm

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 3/8.
 - 2. Chrome-plated, soft-copper flexible tube riser.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224716 - PRESSURE WATER COOLERS

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 pressure water coolers and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers: Wall mounted, wheelchair accessible.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Larco Inc.
 - 2. Cabinet: Bi-level with two attached cabinets.
 - 3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - 4. Control: Push button.
 - 5. Drain: Grid with NPS 1-1/4 tailpiece.
 - 6. Supply: NPS 3/8 with shutoff valve.
 - 7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.

8. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 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.
9. Capacities and Characteristics:
 - a. Cooled Water: 8 gph.
 - b. Ambient-Air Temperature: 90 deg F.
 - c. Inlet-Water Temperature: 80 deg F.
 - d. Cooled-Water Temperature: 50 deg F.
 - e. Electrical Characteristics:
 - 1) Volts: 120-V ac.
 - 2) Phase: Single.
 - 3) Hertz: 60.
10. Support: ASME A112.6.1M, Type I water-cooler carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set freestanding pressure water coolers on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

DIVISION 23– HEATING, VENTILATING & AIR CONDITIONING

Section 23 05 13	Common Motor Requirements for HVAC Equipment	3
Section 23 05 29	Hangers and Supports for HVAC Piping & Equipment.....	8
Section 23 05 48	Vibration Controls for HVAC	7
Section 23 05 53	Identification for HVAC Piping and Equipment	7
Section 23 05 93	Testing, Adjusting and Balancing for HVAC	15
Section 23 07 13	Duct Insulation	21
Section 23 08 00	HVAC Commissioning	6
Section 23 09 00	Controls and Instrumentation for HVAC	8
Section 23 11 23	Facility Natural-Gas Piping	10
Section 23 23 00	Refrigerant Piping	9
Section 23 31 13	Metal Ducts	7
Section 23 33 00	Air Duct Accessories.....	6
Section 23 34 16	Centrifugal HVAC Fans.....	4
Section 23 37 00	Air Outlets and Inlets.....	2
Section 23 37 13	Diffusers, Registers, and Grilles	3
Section 23 54 00	Furnaces	7
Section 23 72 00	Air to Air Energy Recovery Equipment	7
Section 23 81 26	Split-System Air-Conditioners	6
Section 23 81 29	Variable Refrigerant Flow HVAC Systems	19
Section 23 82 16	Air Coils.....	3
Section 23 82 39	Unit Heaters	4

DIVISION 24 through DIVISION 25 – not used

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.

3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Support information in this section is for steel pipe only. See spec section
- B. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- C. See Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- D. See Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.

- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

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 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 PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.
 - 3. Globe Pipe Hanger Products, Inc.
 - 4. Grinnell Corp.
 - 5. National Pipe Hanger Corporation.
 - 6. PHD Manufacturing, Inc.
 - 7. PHS Industries, Inc.
 - 8. Piping Technology & Products, Inc.
 - 9. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- 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 beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- F. 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 noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 .
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 , requiring clamp flexibility and up to 4 inches of insulation.

4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. 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 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. 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 for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. 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-joint 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. 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:
 8. Light (MSS Type 31): 750 lb.
 9. Medium (MSS Type 32): 1500 lb.
 10. Heavy (MSS Type 33): 3000 lb.
 11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. 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.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated 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.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. 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 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.

- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Hydronic Piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and 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.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 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 smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 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 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Elastomeric isolation pads and mounts.
 - 2. Restrained elastomeric isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Housed spring mounts.
 - 5. Elastomeric hangers.
 - 6. Spring hangers.
 - 7. Spring hangers with vertical-limit stops.
 - 8. Thrust limits.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.
 - 12. Restraining cables.
- B. Definitions:
 - 1. Effective peak velocity related acceleration coefficient.
 - 2. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment, plus connected piping and ductwork.
- B. The following equipment shall be provided with vibration isolators:
 - 1. Air Handlers
 - 2. Exhaust Fans
 - 3. Pumps
- C. Provide minimum static deflection of isolators for equipment as follows:
 - 1. 400 – 600 rpm: 3.5 inch
 - 2. 601 – 800 rpm: 2 inch
 - 3. 801 – 900 rpm: 1 inch
 - 4. 901 – 1500 rpm: 0.5 inch
 - 5. Over 1500 rpm: 0.2 inch

1.3 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Details for Interlocking Snubbers: Include load deflection curves up to ½-inch (13-mm) deflection in x, y, and z planes.

1.4 SEISMIC RETRAINT REQUIREMENTS

- A. Equipment, piping, ductwork and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces.
- B. All ductwork and piping shall be provided with seismic restraints in accordance with the IBC, UBC, and applicable State and local codes.

1.5 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage pre-approval "R" number, from OSHPD or 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 pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a registered professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code—Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 VIBRATION ISOLATORS

- A. Manufacturers:
 1. Amber/Booth Company, Inc.
 2. B-Line Systems, Inc.
 3. California Dynamics Corp.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control, Inc.
 6. Mason Industries, Inc.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation Co., Inc.
 9. Vibration Mountings & Controls/Korfund.
- B. Type E-1:
 1. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of

sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

- a. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
- b. Minimum $\frac{3}{4}$ " thick.
- c. Max Loading 40 PSI.

C. Type E-2:

1. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
2. Durometer values range from 30 to 70 and are measures of hardness or, indirectly, deflection. Lower durometer values indicate softer material with more deflection.

D. Type E-3:

1. Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint.
 - a. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
 - b. Neoprene: Shock-absorbing materials compounded according to, the standard for bridge-bearing neoprene as defined by AASHTO.

E. Type E-4:

1. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

F. Type S-1:

1. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - a. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - b. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - c. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - d. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - e. Baseplates: Factory drilled for bolting to structure and bonded to $\frac{1}{4}$ -inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
 - f. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

G. Type S-2:

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to $\frac{1}{4}$ -inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

H. Type S-3:

1. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 - a. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - b. Base: Factory drilled for bolting to structure.

- c. Snubbers: Vertically adjustable to allow a maximum of ¼-inch (6-mm) travel before contacting a resilient collar.
- I. Type S-5:
 - 1. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - a. 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.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- J. Type S-5:
 - 1. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - a. 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.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- K. Type T-1:
 - 1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
 - a. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - g. Coil Spring: Factory set and field adjustable for a maximum of ¼-inch movement at start and stop.
- L. Type IB-1
 - 1. Inertia Base.
 - 2. Concrete filled base sized to support equipment without overhanging structural steel members that form perimeter framing. Cutout in center may be provided with structural member interior section to adjust base weight if necessary. Total mass of base shall not be less than two times the total weight of all equipment mounted on base unless otherwise indicated. Submit

calculations for base deflection. Deflection shall be in accordance with 1995 ASHRAE Handbook, Vibration Isolation. Furnish with preset embedded anchor bolts and pipe sleeves for fan and motor slide rail or other equipment attachment. Size base to support suction elbow of end suction pumps and suction and discharge elbow of horizontal split case pumps, unless flexible neoprene elbows are used. Use T-shape where necessary to conserve weight and size.

- M. Type SB-1
 - 1. Structural Steel Base.
 - 2. Structural steel rectangular base with cross members to prevent twisting where longest beam dimension exceeds 6 feet. Use height-saving brackets for side mounting of isolators.
- N. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of ½-inch- thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- O. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of ½-inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers:
 - 1. Amber/Booth Company, Inc.
 - 2. B-Line Systems, Inc.
 - 3. California Dynamics Corp.
 - 4. Kinetics Noise Control, Inc.
 - 5. Loos & Co., Inc.; Cableware Technology Division.
 - 6. Mason Industries, Inc.
 - 7. TOLCO Incorporated.
 - 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 - 9. Vibration Eliminator Co., Inc.
 - 10. Vibration Isolation Co., Inc.
 - 11. Vibration Mountings & Controls/Korfund.
- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
- E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide in accordance with manufacturers instructions.
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
- C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- D. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- E. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- F. Install resilient bolt isolation washers on equipment anchor bolts.
- G. Connect wiring to isolated equipment with flexible hanging loop.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect isolator seismic-restraint clearance.
 - 2. Test isolator deflection.
 - 3. Inspect minimum snubber clearances.

3.3 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust air spring leveling mechanism.
- E. Adjust active height of spring isolators.
- F. Adjust snubbers according to manufacturer's written recommendations.
- G. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- H. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.4 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE

- A. Compressors
 - 1. Type S-2 restrained spring

- 2. Type S-3 seismic spring with snubbers
- B. Internally isolated air handling units and fans
 - 1. Springs provided with air handling units and factory installed inside unit casing.
 - 2. Type neoprene waffle pads between base and floor or housekeeping pad.
- C. Fans and air handling units without internal isolations.
 - 1. Type S-2 restrained spring
 - 2. Type SA-3 seismic spring
 - 3. Type SB-1 structural steel base unless unit includes an integral steel base with isolator mounting locations
- D. Suspended fan coil units and fans.
 - 1. Type S-5 Spring Hanger

END OF SECTION 23 05 48

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. 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: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch 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.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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 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, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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]** **[cover full]** 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 high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch or Aluminum, 0.032-inch 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 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 minimum.
 2. Fasteners: Brass grommet and wire.
 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. 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 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Chilled-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Condenser-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 3. Heating Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 4. Refrigerant Piping:
 - a. Background Color: Orange.
 - b. Letter Color: Black.
 - 5. Low-Pressure Steam Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 6. High-Pressure Steam Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 7. Steam Condensate Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.

3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 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 HVAC terminal devices 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. Chilled Water: 1-1/2 inches, round.
 - b. Condenser Water: 1-1/2 inches, round.
 - c. Refrigerant: 1-1/2 inches, round .
 - d. Hot Water: 1-1/2 inches, round .
 - e. Gas: 1-1/2 inches, round .
 - f. Low-Pressure Steam: 1-1/2 inches, round.
 - g. High-Pressure Steam: 1-1/2 inches, round.
 - h. Steam Condensate: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Chilled Water: Natural.
 - b. Condenser Water: Natural .
 - c. Refrigerant: Natural .
 - d. Hot Water: Natural .
 - e. Gas: Natural .
 - f. Low-Pressure Steam: Natural .
 - g. High-Pressure Steam: Natural .
 - h. Steam Condensate: Natural .
 3. Letter Color:
 - a. Chilled Water: Black.
 - b. Condenser Water: Black.
 - c. Refrigerant: Black.
 - d. Hot Water: Black.
 - e. Gas: Black.
 - f. Low-Pressure Steam: Black.
 - g. High-Pressure Steam: Black.
 - h. Steam Condensate: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by NEBB or TABB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing."

1.4 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

- A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. Energy Control, Inc.
 - 2. Testcomm
 - 3. Riley Engineering, Inc.
 - 4. Precision Air and Water Balance.
 - 5. Air Commander Test & Balance

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at indicated values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with

- calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's

- recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.8 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at full flow through the cooling coil if coil has that capacity.
- B. Adjust each zone damper to indicated airflow.

3.9 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.10 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
 - C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
 - D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
 - E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
 - F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
 - G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.11 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.12 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 - 1. Measure condenser-water flow to each cell of the cooling tower.
 - 2. Measure entering- and leaving-water temperatures.
 - 3. Measure wet- and dry-bulb temperatures of entering air.
 - 4. Measure wet- and dry-bulb temperatures of leaving air.
 - 5. Measure condenser-water flow rate recirculating through the cooling tower.
 - 6. Measure cooling tower pump discharge pressure.
 - 7. Adjust water level and feed rate of makeup-water system.

3.15 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.16 PROCEDURES FOR BOILERS

- A. If hydronic, measure entering- and leaving-water temperatures and water flow.
- B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.17 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.18 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.19 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements

- recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
1. Check duct slopes as required.
 2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.

3.20 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 4. Air balance each air outlet.

3.21 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.22 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.23 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

3.24 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, concealed supply and return.
 - 8. Outdoor, exposed supply and return.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners."

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.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, 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: 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

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. Ductwork Mockups:
 - a. One 10-foot section each of rectangular and round straight duct.
 - b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
 - c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
 - d. One rectangular and round transition fitting.
 - e. Four support hangers for round and rectangular ductwork.
 - f. Each type of damper and specialty.
 - 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 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum 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. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. 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.

- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. CertainTeed Corp.; 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.

- H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied 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. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. 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.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 1-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 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. Johns Manville; Super Firetemp M.

- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

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. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-03/11-70.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."
- C. 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, 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.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."

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, 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; 30-03/11-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 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, 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 at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 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, 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; 60-03/11-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 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, 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 at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 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, 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.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. 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.
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, 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.
 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. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
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. 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. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
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. 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..
 - 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. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84203/1185RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. 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, 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: White.
- D. Metal Jacket:
 - 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. 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, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

- a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with **[white] [stucco-embossed]** aluminum-foil facing.
 - 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. Polyguard Products, Inc.; Alumaguard 60.

2.11 TAPES

- A. 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, 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.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. 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, 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.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 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. 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.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

- 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. 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 thick, 3/4 inch wide with wing seal or closed seal.
- 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch 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, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, 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, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, 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. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, 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 thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum, fully annealed, 0.106-inch-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. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, 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 thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - 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. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, 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 thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum, fully annealed, 0.106-inch-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- thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, 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- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - 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) GEMCO.
 - 2) Midwest Fasteners, Inc.
 - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
 - D. Wire: 0.062-inch soft-annealed, stainless steel.
 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. C & F Wire.
- 2.13 CORNER ANGLES
- A. PVC Corner Angles: **30 mils** thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
 - C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, 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 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.

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 ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. 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.
- 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches 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 duct flanges and fittings.
- 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 beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

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 below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. 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.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. 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.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. 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.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 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 overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- 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 laps at longitudinal seams and 3-inch- 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 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 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 o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

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 099113 "Exterior Painting" and Section 099123 "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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, 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 duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.11 DUCTWORK AND PLENUM INSULATION INSTALLATION

A. General: Insulate the following ducts:

1. Supply air ducts not within conditioned space. R-Value = R-8
2. Return air ducts not within conditioned space. R-Value = R-8
3. Relief air ducts between AHU and exterior space. R-Value = R-8
4. Outside air intakes and ducts within conditioned space. R-Value R-8
5. Supply, return, and outside air ducts in concrete or in ground. R-Value R-6
6. Supply air ducts with supply air temperature $<55^{\circ}\text{F}$ or $>105^{\circ}\text{F}$ within conditioned space. R-Value = R-6
7. Mechanically cooled ducts requiring insulation shall have a vapor retarder jacket.

B. Installation on Concealed Ducts:

1. For all rectangular and all round ducts, insulation shall be attached by applying adhesive around entire perimeter of the duct in 6" wide strips on 12" centers.

2. For rectangular ducts, 24" and larger insulation shall be additionally secured to bottom of ducts by use of mechanical fasteners. Fasteners shall be spaced on 18" centers and not more than 18" from duct corners.
3. Mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18" centers and not more than 18" from duct corners.
4. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to overlap vapor barrier joints 2". The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
5. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back to the washer.
6. Jacket overlaps shall be secured under the overlap with adhesive and stapled on 4" centers.
7. Staples and seams shall be coated with vapor barrier coating.
8. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2" beyond the break or penetration in all directions and shall be secured with adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.
9. At jacket penetrations such as hangers, thermometers and damper operating rods, voids in the insulation shall be filled with vapor barrier coating and the penetration sealed with a brush coat of vapor barrier coating.
10. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.
11. Bands: Bands on 18" centers shall be provided on all insulation on concealed round duct.
12. Flexible Duct Insulation: Flexible ducts have been specified to have factory-applied insulation. This Contractor shall seal all connections with tape.

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. Ducts and Plenums, Concealed:
 1. None.
- D. Ducts and Plenums, Exposed:
 1. None.
 2. PVC: 30 mils thick.
 3. Aluminum, Smooth: 0.020 inch thick.
 4. Painted Aluminum, Smooth: 0.020 inch thick.
 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish 0.016 inch 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. Ducts and Plenums, Concealed:

1. None.
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. Aluminum, Smooth or Corrugated: 0.032 inch thick.
 2. Painted Aluminum, Smooth or Corrugated: 0.024 inch thick.
 3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch thick.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
1. Aluminum, Smooth or Corrugated: 0.032 inch thick.
 2. Painted Aluminum, Smooth or Corrugated: 0.024 inch thick.
 3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch thick.

END OF SECTION 230713

SECTION 23 08 00 HVAC COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to describe the commissioning process specific for those sections found in Division 23.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. GENERAL RESPONSIBILITIES: The Contractor's commissioning responsibilities applicable to the mechanical contractor are as follows:

1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
2. Attend a commissioning kick-off meeting and other meetings necessary to facilitate the Commissioning process.
3. Contractors shall assist in clarifying the installation, operation, maintenance, and control of commissioned equipment if requested by the Commissioning Authority.

- B. COORDINATION

1. Refer to Section 01 91 13 for a listing of all sections where commissioning requirements are found, for systems to be commissioned and for Pre-verification testing requirements.
2. Assist and cooperate with the Controls and TAB contractor and Commissioning Authority by:
 - a. Putting all HVAC components and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Including cost of sheaves and belts that may be required by TAB.
 - c. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
 - d. Install a P/T plug at each water sensor that is an input point to the control system.
 - e. List and clearly identify on the as-built drawings the locations of all instrumentation.
2. Provide to the Commissioning Authority a written sequence of operation for packaged controlled components demonstrating compliance with the sequence of operation found in Division 23. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
3. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:
 - a. Prior to starting TAB, submit to the Contractor the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Commissioning Authority will approve the site technician's qualifications for this project.
 - b. Provide formal progress reports and deficiency reports weekly to the Commissioning Authority.
 - c. Communicate in writing to the controls contractor all set-point and parameter changes made or problems and discrepancies identified during TAB that affect the control system setup and operation.
 - d. Provide a draft TAB report within two weeks of completion. A copy will be provided to the Commissioning Authority. The report will contain a full explanation of the methodology,

assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings.

- 1) Provide a list of all components and systems that perform out of specified parameters.
- 2) Provide the Commissioning Authority with any requested data, gathered, but not shown on the draft reports.
- e. Provide a final TAB report for the Owner's Representative and Commissioning Authority with details, as in the draft.
- f. Participate with the Commissioning Authority in checking performance on the original TAB.

1.3 SUBMITTALS

- A. General Submittals: Contractor shall provide to the Commissioning Authority, through established channels, normal cut sheets and shop drawing submittals, and detailed manufacturer's installation and start-up checklists, for all commissioned equipment.
 1. Provide additional documentation to the Commissioning Authority.
 - a. Detailed operating, troubleshooting and maintenance procedures, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
 - b. The installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians to the Commissioning Authority.
 2. The Commissioning Authority may request further documentation necessary for the commissioning process. This data request may be made prior to normal submittals.
 3. Aid the CA in preparation of the specific functional performance test procedures specified in Section 019113. Subcontractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
- B. Mechanical Contractor Submittals: Prepare a preliminary schedule for pipe and duct system testing, flushing and cleaning, component start-up and completion for use by the Contractor in developing the startup plan. Update the schedule as appropriate.
- C. TAB Contractor: Submit the outline of the TAB plan and approach for each system and component to the Owner's Representative, Commissioning Authority, and the Controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.
 1. The submitted plan will include:
 - a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
 - b. An explanation of the intended use of the DDC. The controls contractor will comment on feasibility of the plan.
 - c. All field checkout sheets and logs to be used that list each component to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / sub-main proportioning, total flow calculations, rechecking, diversity issues, expected problems and

- solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the waterside.
- g. List of all airflow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - h. Details of how *total* flow will be determined (Air: sum of terminal flows via DDC calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
 - i. The identification and types of measurement instruments to be used and their most recent calibration date.
 - j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
 - k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.
 - l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).
 - m. Details of how building static and exhaust fan / relief damper capacity will be checked.
 - n. Proposed selection points for sound measurements and sound measurement methods.
 - o. Details of methods for making any specified coil or other system plant capacity measurements.
 - p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
 - q. Details regarding specified deferred or seasonal TAB work.
 - r. Details of any specified false loading of systems to complete TAB work.
 - s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - t. Details of any required interstitial cavity differential pressure measurements and calculations.

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation Checklists: The Contractor shall complete the checklist(s) provided with the Facility Grid app.
 - 1. The completion of these checklists does not limit the Contractor's responsibilities for quality control and scheduling as indicated elsewhere in the documents, nor does this checklist include all submittal, inspection, or quality assurance requirements for the work of this Section.
 - 2. Complete the installation checklists for each component and each system to be commissioned with the Facility Grid app and updated at a minimum of once per week.
 - a. The field technician or installer should complete the updates that will be logged by Facility Grid.
 - b. The installer should be aware of the importance of proper installation and that verification of the installation of components will be on going through out construction by the Commissioning Authority.
 - c. The checklists are available for review by the Construction team and Commissioning Authority at any time by logging in to Facility Grid.

3.2 Start Up Activities

- A. General Requirements: Develop a project start-up plan using manufacturer's start-up procedures and the installation checklists for all commissioned components. Submit to Commissioning Authority for review and approval 14 days prior to startup. Refer to Division 01 90 13 for further details on the start-up plan.
 - 1. Notify the Owner's Representative and Commissioning Authority, when pipe and duct system testing, flushing, cleaning, startup of each component and TAB will occur. Be responsible to notify the Owner's Representative and Commissioning Authority, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction.
- B. Mechanical Contractor: Provide startup for all HVAC components, except for the building automation control system.
 - 1. The HVAC mechanical and controls contractors shall follow the start-up plan. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Authority or Owner.
 - 2. During the startup and initial checkout process, execute the mechanical-related portions of the installation checklists for all commissioned components.
 - 3. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Architect and Commissioning Authority.
 - 4. Provide skilled technicians to execute starting of components. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
- C. TAB Contractor: Coordinate with the mechanical and controls contractors for components and systems that have completed startup.

3.3 Pre-Verification Testing (PVT): The Contractor will perform the Pre-verification tests as provided with the Facility Grid app. The PVT's will be done on all equipment and systems outlined in Division 01 90 13. When all pre-verification testing has been completed, the CA will schedule Functional Performance testing and substantial completion may be issued.

3.4 CLOSEOUT ACTIVITIES

- A. Functional Performance Testing (FPT): The CA shall verify that the PVT's were done and complete by running the FPT's in the Facility Grid app.
- B. Functional Performance testing is intended to begin upon completion of a system and after Pre-verification testing, is complete. Functional Performance testing may proceed prior to the completion of systems or sub-systems at the discretion of the Owner's Representative and Commissioning Authority. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all construction checklists and Pre-verification tests as soon as possible.
- C. Mechanical Contractor: Provide skilled technicians to assist with functional performance testing under the direction of the Contractor for specified components in Division 01 90 13.
- D. TAB Contractor: The CA may verify the accuracy of the TAB work prior to commencing Functional Performance testing activities that may be adversely affected by improper balancing.

1. Test, Adjust, and Balance (TAB) Reports: After TAB activities are completed; submit report to the Commissioning Authority and the Architect's consultant.
 - a. Identify the following:
 - 1) Systems or subsystems for which final balancing is complete.
 - 2) Status of deficiencies and balancing issues encountered, including corrective actions taken.
 - 3) Plan & Schedule for completion of unfinished work.
- B. Operation and Maintenance Manuals: The approved complete manuals must be on site prior to training.
 1. Requirements for Operations and Maintenance Manuals is found in Division 1.
 2. TAB Contractor: The TAB will compile and submit the following with other documentation that may be specified elsewhere in the Specifications.
 3. Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.
 4. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.
- C. Training: The Owner personnel shall be trained on procedures related to the list in 1.1A above.
 1. Requirements for Training are listed in Division 1.
 2. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 3. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:
 - a. Provide the Owner's Representative and Commissioning Authority with a training plan and training checklists two weeks before the planned training for approval.
 - b. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of all HVAC components.
 - c. The appropriate trade or manufacturer's representative shall provide the instructions on each major component. This person may be the start-up technician for the component, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific component is required. More than one party may be required to execute the training. Training cannot coincide with startup or other contract requirements.
 - d. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.
 4. Duration of Training: The appropriate contractor shall provide training on each component as required in this Division and the main specifications in Division 1.
- D. TAB Contractor: The TAB contractor shall have the following training responsibilities:
 - a. TAB shall meet with Owner's personnel after completion of TAB and instruct them on the following:
 - 1) Go over the final TAB report, explaining the layout and meanings of each data type.
 - 2) Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 - 3) Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - 4) Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - 5) Other salient information that may be useful for facility operations, relative to TAB.

3.3 DOCUMENTS REQUIRED

- A. The General Contractor will provide the following documentation before Final Acceptance:
1. Completed Inspection Forms with approval signatures of all Authority Having Jurisdiction.
 2. Approval Signature of Engineer of Record
 3. Training Attendance Sheets with Agenda

END OF SECTION

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes control equipment for HVAC systems and components, including control components for heating and cooling systems, fans & energy recovery ventilators.

1.2 SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Damper schedule.
 - 5. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 6. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Software and firmware operational documentation.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Alerton Inc.

2. Automated Logic

- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- C. Building Automation System Interface
 - 1. The Building Automation System (BAS) shall send the heating/cooling equipment a Discharge Air Temperature Setpoint. The BAS shall also send Start-up, Occupied, Unoccupied, Morning Warm-up, Heating / Cooling, Economizer enable, Timed Override, Startup, Demand Limit, Duty Cycle, and Priority Shutdown commands.
 - 2. If communication with the BAS is lost, the heating/cooling equipment shall use it's default setpoints and operates in the Occupied Cooling mode. The Economizer function is enabled based on the Outdoor Air Temperature Sensor.

2.3 DDC EQUIPMENT

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - 3. Local operator interface provides for download from or upload to operator workstation.

- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation[with three-position (on-off-auto) override switches and status lights].
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA)[with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer].
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. [Perform scheduling with real-time clock.]Perform automatic system diagnostics; monitor system and report failures.
 3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F , and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Zone Sensors
 - 1. The zone sensor shall be accurate to within 0.5 F. The sensor shall be a product of the manufacturer and designed specifically for the installed controller.
 - 2. The adjustable zone sensor shall have the following features:
 - a. Zone setpoint adjustment
 - b. Night setback temperature override button to provide occupied conditions during unoccupied times.
- C. RTDs and Transmitters:
 - 1. Accuracy: Plus or minus 0.2 percent at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - 4. Averaging Elements in Ducts: 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. length as required.
 - 5. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
- D. Pressure Transmitters/Transducers:
 - 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.

- d. Duct Static-Pressure Range: 0- to 5-inch wg .
- 2. Differential-Pressure Switch (Air): Snap acting, with pilot-duty rating and with suitable scale range and differential.
- 3. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

2.7 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- D. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- F. Electronic Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.8 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Comply with requirements in Division 23 Section "Motors."
 - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 3. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 4. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. : Size for running and breakaway torque of 150 in. x lbf .
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - a. Belimo Aircontrols (USA), Inc.
 - 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.

- e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm : Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm : Increase running torque by 2.0.
3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 6. Power Requirements (Two-Position Spring Return): [24] [120] [230]-V ac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: Minus 22 to plus 122 deg F .
 10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F .
 11. Run Time: 12 seconds open, 5 seconds closed.

2.9 DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. TAMCO (T. A. Morrison & Co. Inc.).
4. United Enertech Corp.
5. Vent Products Company, Inc.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf ; when tested according to AMCA 500D.

2.10 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 16 Section "Voice and Data Communication Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify location of thermostats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor, unless dictated otherwise by the ADA Code.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- B. Install guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- C. Install automatic dampers according to Division 23 Section "Duct Accessories."
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section "Mechanical Identification."
- F. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 6. Check temperature instruments and material and length of sensing elements.
 - 7. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

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.

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, crawlspaces, 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 minimum unless otherwise indicated.
 - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 3. Pressure regulators. Indicate pressure ratings and capacities.
 - 4. Dielectric fittings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators 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.

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 083113 "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. Mechanical Couplings:
 - a. Basis-of-design product: Subject to compliance with requirements, provide Viega LLC; MegaPress fitting system or a comparable product by one of the following:
 - 1) Kembla.
 - b. Fittings: Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of IAPMO PS117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have Smart Connect feature design (leakage path).
 - c. Pipe Thread: Pipe threads shall conform to ASTM B16.3
 - d. Hangers and supports: Hangers and supports shall conform to MSS SP 58.
 - e. Hanger spacing: In accordance with ASME B 31.1, NFPA54, UPC, IMC and applicable national and local codes
 - f. Fittings shall be listed and approved for their intended application.

2.2 PIPING SPECIALTIES

- A. 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.
- B. 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 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.

2.3 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 1. Threaded Ends: Comply with ASME B1.20.1.
 2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 3. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. Full-Port, Bronze Butterfly Valves with Bronze Trim.
 1. Manufacturers: Basis-of-design product: Subject to compliance with requirements, provide Milwaukee; BB2-100 model or a comparable product by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.

- b. Conbraco Industries, Inc.; Apollo Div.
- c. McDonald, A. Y. Mfg. Co.
- d. Nibco
- 2. Body: Bronze, complying with ASTM B 584.
- 3. Disk: Stainless steel.
- 4. Stem: Stainless steel.
- 5. Seat: Viton.
- 6. Packing: Nylon.
- 7. Ends: Threaded.
- 8. Rating: 175 psig WOG.
- 9. Listing: Valves NPS 1 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.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, 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 minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, 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 minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements, 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.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.5 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 and smaller.
- B. 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]:
 - 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.
 - 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 - 6. Orifice: Aluminum; interchangeable.
 - 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 - 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 - 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 - 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 - 12. Maximum Inlet Pressure: 2 psig.

2.6 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 wide and 4 mils 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 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 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. 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. Apply anti-corrosive paint to steel pipe w/o PE coating and color match to building
- C. Install fittings for changes in direction and branch connections.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with 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 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 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 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 sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 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.

3.6 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

- B. Comply with requirements for pipe hangers and supports specified in Section 230529 "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 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 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 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.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to 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.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.12 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with Viega LLC; MegaPress fitting system.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, piping NPS 2 and smaller shall be the following:
1. Steel pipe with Viega LLC; MegaPress fitting system.
 2. Steel pipe with malleable-iron fittings and threaded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground, piping NPS 2 and smaller shall be the following:
1. Steel pipe with Viega LLC; MegaPress fitting system.
 2. Steel pipe with malleable-iron fittings and threaded joints.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
1. One-piece, full-port, bronze butterfly valves with bronze trim.

END OF SECTION 23 11 23

SECTION 23 23 00 – REFRIGERATION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410a:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L drawn-temper tubing.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig .
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.

3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F .
6. Superheat: .
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.

4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig .
7. Working Pressure Rating: 500 psig .
8. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Working Pressure Rating: 500 psig .
7. Maximum Operating Temperature: 240 deg F .

M. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A:

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type L drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install flexible connectors at compressors.

3.3 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 Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 15 Sections "Controls and Instrumentation, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 8 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.

- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 7 Section "Through-Penetration Firestop Systems."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 7 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828.
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches ; minimum rod size, 1/4 inch
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch .
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch .

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

- a. Supply Ducts: 2-inch wg.
- b. Supply Ducts (Upstream from Air Terminal Units): 4-inch wg.
- c. Supply Ducts (Downstream from Air Terminal Units): 2-inch wg.
- d. Return Ducts (Negative Pressure): 2-inch wg.
- e. Exhaust Ducts (Downstream of Fan): 2-inch wg.
- f. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Sealant Class:

- a. Supply Ducts : Class C.
- b. Supply Ducts (Upstream from Air Terminal Units): Class A.
- c. Supply Ducts (Downstream from Air Terminal Units): Class C.
- d. Return Ducts (Negative Pressure): Class C.
- e. Exhaust Ducts (Downstream of Fan): Class C.
- f. Exhaust Ducts (Negative Pressure): Class C.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Factory- and shop-fabricated ducts and fittings.
 - 2. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

PART 2 - PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS

- A. Duct sizes shown on drawings are outside nominal dimensions for sheet metal ductwork. Where ductwork is indicated on the drawings to be lined, an allowance for 1" or 2" thick insulation is included and duct sizes do not need to be increased to compensate for the insulation.
- B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Rectangular to round branch duct connections shall use spin-in fittings: Spin-in fittings shall be DuroDyne or Air Control Products equal to Air Control Products Model S-SM-C with damper for unlined ductwork or Air Control Products Model S-DB-C with damper for lined ductwork.
- G. Rectangular to rectangular branch duct connections shall use 45 degree entry. Straight taps are not allowed.
- H. Rectangular Elbows: All 90 degree rectangular elbows shall contain turning vanes. See section 15820 "Duct Accessories" for turning vane fabrication requirements.

2.02 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 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. McGill AirFlow LLC.
 - b. SEMCO Incorporated.
 - c. Sheet Metal Connectors, Inc.
 - d. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Round ducts and fittings: All round ductwork shall be spiral lock seams with spot welded sealed manufactured fittings, galvanized steel.
- F. Round Elbows: All round elbows shall be pleated or segmented with a centerline radius of 1.5 times the cross section diameter.

2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 45 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

2.05 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- B. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections. Fittings shall be full bodied fittings on all new duct installations. Saddle fittings shall only be allowed on connections to existing duct work.
- C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- F. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- G. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- H. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.02 SEAM AND JOINT SEALING

- A. Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum

Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.04 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.05 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel:
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1500 fpm or lower:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- D. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1500 fpm or Lower: Conical tap.
 - b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Turning vanes.
 - 3. Duct-mounted access doors.
 - 4. Flexible connectors.
 - 5. Flexible ducts.
 - 6. Duct accessory hardware.

1.02 SUBMITTALS

- A. Product Data: For the following:
 - 1. Manual Volume dampers.
 - 2. Flexible connectors.
 - 3. Flexible ducts.
- B. Operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.

- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 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. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 16 gauge minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 16 gauge thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze.

- b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
 - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.03 TURNING VANES

- 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. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.04 FLEXIBLE DUCTS

- 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. Thermaflex.
 - 2. Genflex
 - 3. Thermold

4. Wiremold
- B. Up to 2" W.G. Pressure Class:
1. Flexible duct shall be a factory assembly consisting of a spring steel helix, inner liner wrapped with 1" thick fiberglass insulation and a vapor barrier outer jacket. Composite assembly, including insulation and a vapor barrier, shall meet U.L. 181 and the Class 1 requirements of NFPA 90-A. Flexible duct shall be Thermaflex G-KKM, Thermold, Genflex or Wiremold.
- C. 4" W.G. Pressure Class:
1. Flexible duct shall be a factory assembly consisting of a spring steel helix, inner liner wrapped with 1" thick fiberglass insulation and a vapor barrier outer jacket. Composite assembly, including insulation and a vapor barrier, shall meet U.L. 181 and the Class 1 requirements of NFPA 90-A. Flexible duct shall be equal to Thermaflex M-KC. Duct shall be designed for 4" pressure application.
- D. Flexible Duct Clamps: Nylon strap in sizes 3 through 18 inches to suit duct size.

2.01 DUCT-MOUNTED ACCESS DOORS

- 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. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Elgen Manufacturing.
 5. Flexmaster U.S.A., Inc.
 6. Greenheck Fan Corporation.
 7. McGill AirFlow LLC.
 8. Nailor Industries Inc.
 9. Pottorff.
 10. Ventfabrics, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.02 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install combination fire/smoke dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 1. On both sides of duct coils.
 2. Adjacent to and close enough to combination fire/smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

- 3. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Minimum Sizes:
 - 1. One-Hand or Inspection Access: 8 by 6 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backward-inclined centrifugal fans.
 - 2. Forward-curved centrifugal fans.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

PART 2 - PRODUCTS

2.1 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Fan Group North America.
 - 2. Acme Engineering & Mfg. Corp.
 - 3. Aerovent; a Twin City Fan Company.
 - 4. Airmaster Fan Co.
 - 5. Ammerman; General Resource Corp.
 - 6. Bayley Fans; a division of Lau Industries, Inc.

7. Carrier Corporation.
 8. Central Blower Company.
 9. Chicago Blower Corporation.
 10. Cincinnati Fan.
 11. CML Northern Blower Inc.
 12. Howden Fan Co.
 13. Industrial Air; a division of Lau Industries, Inc.
 14. Loren Cook Company.
 15. Madison Manufacturing.
 16. New Philadelphia Fan Co.
 17. New York Blower Company (The).
 18. Trane.
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Spun inlet cone with flange.
 3. Outlet flange.
- D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 2. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 4. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 5. Motor Mount: Adjustable for belt tensioning.
- G. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
 3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 5. Discharge Dampers: Assembly with parallel or opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 6. Inlet Screens: Grid screen of same material as housing.
 7. Spark-Resistant Construction: AMCA 99.
 8. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 9. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
- H. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.

2.2 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. 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 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using spring isolators having a static deflection of 1inch deflection. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

- E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 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. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233416

SECTION 233700 – AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions of the Subcontract apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
 - 1. Outside louvers.
 - 2. Goosenecks.
- C. Related Sections:
 - 1. Division 01 Section "General Requirements."
 - 2. Division 01 Section "Special Procedures."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing for HVAC".

1.2 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
 - 4. Refer to Division 23 Section "Common Results for HVAC" for codes and standards, and other general requirements.
- B. Air Diffuser Council (ADC):
 - 1. ADC Applicable Standards.
- C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
 - 1. ASHRAE 52 Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - 2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems

1.3 SUBMITTALS

- A. Submit under provisions of Division 23 Section "Common Results for HVAC, Review of Materials" and Division 01 Section "General Requirements."
- B. Shop Drawings:
 - 1. Check location of outlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
 - 2. Review requirements of outlets as to size, finish, and type of mounting prior to submitting shop drawings and schedules of outlets.

- C. Product Data: Cover each item, together with schedule of outlets, and manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- A. Make airflow tests and sound-level measurements in accordance with applicable ADC equipment test codes 1062 and ASHRAE 70
- B. Manufacturer shall certify cataloged performance and ensure correct application of air-outlet types.

PART 2 - PRODUCTS

2.1 OUTSIDE LOUVERS

Manufactures:

- 1. Ruskin
- 2. Greenheck

- B. Provide louvers 6 inches (150 mm) deep with blades on 45-degree slope, heavy channel frame, bird screen with 1/2-inch (13-mm) square mesh for exhaust and intake.
- C. Fabricate of 12-gauge (2.1-mm) extruded aluminum and provide welded assembly.
- D. Finish in factory baked-enamel, color to be determined by architect.
- E. See schedules on M6.01 for basis of design

2.2 GOOSENECKS

- A. Fabricate goosenecks of 18-gauge (1.2-mm) or heavier galvanized steel.
- B. Mount on at least 12-inch (300-mm) high curb base where size exceeds 9 inches (225 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' printed instructions.
- B. Paint interior of ductwork matt-black where it is visible behind air outlets.

END OF SECTION 233700

SECTION 233713 DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.02 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

2.02 GRILLES AND REGISTERS

- A. Adjustable Bar Grille.
 - 1. Manufacturers:
 - a. Anemostat; a Mestek Company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries of Texas Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
 - 2. Material: Steel or aluminum as scheduled.
 - 3. Finish: Baked enamel, white unless noted otherwise on the drawings.
 - 4. Face Blade Arrangement: Adjustable horizontal spaced as indicated on the drawings.
 - 5. Rear Blade Arrangement: Adjustable vertical spaced as indicted on the drawings.
 - 6. Frame: 1-1/4 inches wide.
 - 7. Mounting: As indicated on the drawings.

8. Damper Type: As indicated on the drawings.
- B. Fixed Face Grille:
1. Manufacturers:
 - a. Anemostat; a Mestek Company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries of Texas Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
 - h. Ruskin
 2. Material: Steel or aluminum as scheduled.
 3. Finish: Baked enamel, white unless noted otherwise on the drawings.
 4. Face Blade Arrangement: Fixed horizontal spaced as indicated on the drawings.
 5. Frame: 1-1/4 inches wide.
 6. Mounting: As indicated on the drawings.
 7. Damper Type: As indicated on the drawings.

2.03 CEILING DIFFUSER OUTLETS

- A. Square Adjustable Core Ceiling Diffusers:
1. Manufacturers:
 - a. Anemostat; a Mestek Company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries of Texas Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
 2. Material: Steel or Aluminum as scheduled on the drawings.
 3. Finish: Baked enamel, white unless noted otherwise on the drawings.
 4. Face Size: 24 by 24 inches for lay-in mounted diffusers.
 5. Face Style: Louvered four core.
 6. Mounting: Surface or T-bar as scheduled on the drawings.
 7. Pattern: Adjustable.
 8. Dampers: As scheduled on the drawings.
 9. Accessories:

- a. Square to round neck adaptor as required.

2.04 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.02 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 235400 - FURNACES

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. Gas-fired, condensing furnaces and accessories complete with controls.
 - 2. Air filters.
 - 3. Refrigeration components.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:
 - 1. Furnace.
 - 2. Air filter.
 - 3. Refrigeration components.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each furnace to include in emergency, operation, and maintenance manuals for each of the following:
 - 1. Furnace and accessories complete with controls.
 - 2. Air filter.
 - 3. Refrigeration components.

1.6 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. Disposable Air Filters: Furnish two complete sets.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:
 - 1. Warranty Period, Commencing on Date of Substantial Completion:
 - a. Furnace Heat Exchanger: 10 years.
 - b. Integrated Ignition and Blower Control Circuit Board: Five years.
 - c. Draft-Inducer Motor: Five years.
 - d. Refrigeration Compressors: 10 years.

PART 2 - PRODUCTS

2.1 GAS-FIRED FURNACES, CONDENSING

- 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. Bryant Heating & Cooling Systems; Div. of United Technologies Corp.
 - 2. Carrier Corporation; Div. of United Technologies Corp.

3. Heil Heating & Cooling Products; a division of International Comfort Products, LLC.
 4. Lennox Industries Inc.
 5. Luxaire Corporation; a division of Unitary Products Group.
 6. Rheem Manufacturing Company; Air Conditioning Division.
 7. Ruud Air Conditioning Division.
 8. Trane.
 9. York International Corp.; a division of Unitary Products Group.
- B. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3, "Gas-Fired Central Furnaces," and with NFPA 54.
- C. Cabinet: Steel.
1. Cabinet interior around heat exchanger shall be factory-installed insulation.
 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
 3. Factory paint external cabinets in manufacturer's standard color.
 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
1. Fan Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- E. Type of Gas: Natural.
- F. Heat Exchanger:
1. Primary: Aluminized steel.
 2. Secondary: Stainless steel.
- G. Burner:
1. Gas Valve: 100 percent safety main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- H. Gas-Burner Safety Controls:
1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- I. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings pre-purges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.
- J. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories.

K. Accessories:

1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through outside wall.

L. Capacities and Characteristics:

1. As scheduled on the drawings.

2.2 AIR FILTERS

- A. Disposable Filters: 2-inch thick fiberglass media with ASHRAE 52.2 MERV rating of 6 or higher, in sheet metal frame.

2.3 REFRIGERATION COMPONENTS

A. General Refrigeration Component Requirements:

1. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.
2. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

- B. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 203/110, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet complying with ASHRAE 62.1.

1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.

- C. Refrigerant Line Kits: Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.

1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 1 inch thick.

- D. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping."

E. Capacities and Characteristics:

1. As scheduled on the drawings:
2. Compressor-Condenser Unit:
 - a. Minimum Cooling Energy Efficiency (SEER): 14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
 - 1. Install seismic restraints to limit movement of furnace by resisting code-required seismic acceleration.
- C. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
 - 1. Anchor furnace to substrate to resist code-required seismic acceleration.
- D. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.
- E. Install ground-mounted, compressor-condenser components on 4-inch-thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

3.3 CONNECTIONS

- A. Gas piping installation requirements are specified in Section 231123 "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a cap and in an arrangement that will protect against entry of birds, insects, and dirt.

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. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - c. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - d. Requirements for Low-Emitting Materials:
 - 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) 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).
 - 3) 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).
 - 4) 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."
4. Slope pipe vent back to furnace or to outside terminal.

D. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."

E. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.

1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."
2. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Comply with requirements in Section 232300 "Refrigerant Piping" for installation and joint construction of refrigerant piping.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

3.5 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 1. Inspect for physical damage to unit casings.
 2. Verify that access doors move freely and are weathertight.
 3. Clean units and inspect for construction debris.
 4. Verify that all bolts and screws are tight.
 5. Adjust vibration isolation and flexible connections.
 6. Verify that controls are connected and operational.
- B. Adjust fan belts to proper alignment and tension.
- C. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- D. Measure and record airflows.
- E. Verify proper operation of capacity control device.
- F. After startup and performance test, lubricate bearings.

3.6 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.7 CLEANING

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235400

SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY 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. Indoor Packaged energy recovery units.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which equipment or suspension systems will be attached.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of each type of filter specified.

1.8 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. ARI Compliance:
 1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
 2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."
- C. ASHRAE Compliance:
 1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
- D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.
- E. UL Compliance:
 1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
 2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.9 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 INDOOR PACKAGED ENERGY RECOVERY UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Advanced Thermal Technologies.
 2. American Energy Exchange, Inc.
 3. Applied Air; Mestek Technology, Inc.
 4. Carnes.
 5. Des Champs Technologies.
 6. Engineered Air.
 7. Fairchild Industrial Products Company.

8. Gaylord Industries, Inc.
9. Greenheck Fan Corporation.
10. Loren Cook Company.
11. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
12. Mitsubishi Electric Sales Canada Inc.
13. RenewAire LLC.
14. Ruskin
15. SEMCO Incorporated.
16. Trane; American Standard Companies, Inc.

B. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, plate and frame or empathy wheel filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

C. CABINET

1. Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
 - a. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Corrosion rates can vary greatly depending on environmental factors, yet it is common acceptance that the life of zinc is a linear function of the coating mass. To obtain a higher life expectancy for an application, the user should utilize twice the coating mass. Ex. A G90 coating mass will exhibit approximately 150% longer life than the G30 coating. [Unit's exterior shall be supplied from the manufacturer using G60 galvaneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours.] This is Greenheck's PermatectorTM option. [Unit's exterior shall be supplied from the manufacturer using G60 galvaneal steel with a baked enamel finish.] Greenheck's baked enamel finish is available in 7 standard colors with a match color chip option. Enamel coatings offer good color and gross retention in exterior applications and have reasonably to excellent chemical resistance properties, further performance information can be supplied upon request. [Unit's exterior shall be supplied from the manufacturer using G60 galvaneal steel with a high performance proprietary coating that has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 5,000 hours.] Greenheck's high performance coating (Hi-Pro Poly) is only available in the following finish color; Concrete Gray-RAL 7023.]
 - b. Internal assemblies: 18 gauge, galvanized (G90) steel
2. Access doors shall be hinged.
3. Shall have factory-installed duct flanges on all duct openings.
4. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
 - a. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - 1) Thickness: 1 inch (25 mm)
 - 2) Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
 - 3) Location and application: Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.

5. Energy wheel: Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned drive belt with a five-year warranty. Note to A/E: Various energy wheel manufacturers are known to build non-segmented wheels. Segmented wheels are known to provide substantial time and labor-saving benefits over the entire life of the energy wheel. The wheel media shall be a polymer film matrix in a stainless-steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film and shall be designed and constructed to permit cleaning and servicing. The energy wheel is to have a five-year warranty. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.
6. Supply Air and Exhaust Air blower assemblies: Blower assemblies consist of an electric motor as specified by A/E and a belt driven blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125-inch-thick neoprene vibration isolators.
7. Control panel / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections
8. Frost control: modulating wheel.
9. Modulating frost control. Control system shall include an outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
10. Motorized dampers / Exhaust Air, Intake Air: Motorized dampers of low leakage type shall be factory installed.

D. BLOWER

1. Blower section construction, Supply Air and Exhaust Air: Belt drive motor and blower shall be assembled onto a 14-gauge galvanized steel platform and must have neoprene vibration isolation devices.
2. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
3. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
4. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
5. Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

E. MOTORS

1. General: Blower motors greater than $\frac{3}{4}$ horsepower shall be "NEMA Premium™" unless otherwise indicated. Minimum compliance with EPCAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.
2. Motors shall be Select one 60 cycle, 1 phase 208 volts. The designation "NEMA Premium™" applies to electric motors with efficiencies that are "better than EPCAct". The terms "high efficiency" or "premium efficiency" have no industry definitions.

F. UNIT CONTROLS:

1. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). [This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors]. Note: if unit is to be connected to a BMS, a factory-installed DDC controller is required. If there is no BMS, either a DDC controller, a remote panel or controls by others must be specified. If a remote panel is specified, make certain that any needed control switches are included in the remote panel.
2. [Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable]. Note: some manufacturers are known to incorporate DDC controllers that require the use of separately-purchased handheld hardware or a PC and/or software to view or change settings. Owner-specified ventilating conditions can be input by means of pushbuttons.
3. Sensors
 - a. Dirty Filter Sensor
 - b. Temperature Sensors- OAI, EAW, RAI, OAD, OAAW

G. FILTERS

1. MERV8 disposable pleated filters shall be provided in the intake air stream and MERV8 filters in the exhaust air stream]. Note: 2" thick MERV 8 filters are standard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting: Install air-to-air energy recovery equipment on concrete bases. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- B. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install units with clearances for service and maintenance.
- D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- E. Pipe drains from drain pans to nearest floor drain; use ASTM B 88, Type L, drawn-temper copper water tubing with soldered joints, same size as condensate drain connection.
- F. Pipe drains from drain pans to nearest floor drain; use ASTM D 1785, Schedule 40 PVC pipe and solvent-welded fittings, same size as condensate drain connection.
 1. Requirements for Low-Emitting Materials:
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Requirements for Low-Emitting Materials: 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."

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Connect piping to units mounted on vibration isolators with flexible connectors.
- D. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."
- E. Install electrical devices furnished with units but not factory mounted.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Adjust seals and purge.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 4. Set initial temperature and humidity set points.
 5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- 3.5 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 00

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.06 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. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.07 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: One year(s) from date of Substantial Completion.
 - b. For Parts: One year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 - 2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 - 3. SANYO North America Corporation; SANYO Fisher Company.
 - 4. Trane; a business of American Standard companies.
 - 5. YORK; a Johnson Controls company.

2.02 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: Permanent, cleanable.
8. Condensate Drain Pans:
 - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 2 inches deep.
 - b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.03 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Multi-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.04 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Condensate Pump.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement,

and formwork are specified in Section 033000 "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

- D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- E. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- F. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. See Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- G. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[and return] ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 238129 - VARIABLE REFRIGERANT VOLUME HVAC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes variable refrigerant volume HVAC equipment and support systems

1.3 PERFORMANCE REQUIREMENTS

- A. See mechanical schedule for performance data

1.4 ACTION SUBMITTALS

- A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For compressor and condenser units 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members to which compressor and condenser units will be attached.
 - 2. Liquid and vapor pipe sizes.
 - 3. Refrigerant specialties.
 - 4. Piping including connections, oil traps, and double risers.

5. Compressors.
6. Evaporators.

- B. Seismic Qualification Certification: For compressor and condenser units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.7 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. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."
- D. ASME Compliance: Fabricate and label water-cooled compressor and condenser units to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- C. Coordinate location of piping and electrical rough-ins.

1.9 WARRANTY

1. Warranty applies to compressor and all parts and is limited in duration to ten (10) years starting from the "installation date" which is one of the two dates below:
 - a. The installation date is the date that the unit is originally commissioned, but no later than 18 months after the manufacture date noted on the unit's rating plate.
 - b. If the date the unit is originally commissioned cannot be verified, the installation date is three months after the manufacture date.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. DESIGN BASIS:

1. The HVAC equipment basis of design is Daikin North America. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein (see Appendix A HVAC Equipment Alternate General Information). In any event, the contractor shall be responsible for all specified items and intents of this document without further compensation.

2.02 HVAC SYSTEM DESIGN

A. SYSTEM DESCRIPTION:

1. The variable capacity heat recovery air conditioning system shall be a Daikin Variable Refrigerant Volume Series (heat or cool model) system as specified.
2. The system shall consist of multiple evaporators, branch selector boxes, REFNET™ joints and headers, a three-pipe refrigeration distribution system using PID control and Daikin VRV^a condenser unit.
3. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.
4. The condensing unit may connect an indoor evaporator nominal capacity up to 200% of the condensing unit nominal capacity. All zones are each capable of operating separately with individual temperature control.
5. A dedicated hot gas pipe shall be required to ensure optimum heating operation performance.
 - a. Two-pipe, heat recovery systems utilizing a lower temperature mixed liquid/gas refrigerant to perform heat recovery are not acceptable due to reduced heating capabilities.
6. The Daikin condensing unit shall be able to connect to indoor unit models CXTQ, FXFQ, FXHQ, FXMQ, FXLQ, FXNQ, FXSQ, FXTQ, FXDQ, FXZQ, FXUQ, FXEQ, FXAQ and FXMQ_MF, and shall range in capacity from 5,800 Btu/h to 96,000 Btu/h in accordance with Daikin's engineering data book detailing each available indoor unit.
 - a. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.
7. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box (BSQ_T / BS_Q54T / BSF_Q54T). Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BMS interface.
8. Branch selector boxes:
 - a. The branch selector boxes shall have the capacity to control up to 290 MBH (cooling) downstream of the branch selector box.

- b. Each branch of the branch selector box shall consist of three electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the box and main processor and between the box and indoor units.
 - c. The branch selector box shall control the operational mode of the subordinate indoor units. The use of three EEV's ensures continuous heating during defrost (multiple condenser systems), no heating impact during changeover and reduced sound levels.
 - d. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.
9. The REYQ_AA condensing unit model numbers and the associated number of connectable indoor units per REYQ_AA condensing unit is indicated in the following table. Each indoor unit or group of indoor units shall be independently controlled.

MODEL NUMBER	NOMINAL CAPACITY (Tons)	MAXIMUM NUMBER OF INDOOR UNITS
REYQ168AATJ*	14	29

B. VRV EMERION FEATURES AND BENEFITS

1. Voltage Platform - The condensing units shall be available with a 208-230V/3ph/60 Hz power supply.
2. Single-module outdoor units shall be available from 6 to 20 T in nominal cooling capacity and can be combined to offer up to 40 T in a dual-module configuration, which helps minimize the overall space required for mechanical equipment and optimize total project costs.
3. The condensing unit shall feature a sealed E-box with a minimum of IP55 rating to provide high dust and moisture protection for reliability
4. Gas Furnace Connectivity – Heat Pump condensing units shall be connectable to Daikin Communicating gas furnaces with AFUE ranging from 80% to 97%.
5. System shall be capable of connecting to multiple VRV A-coils (CXTQ) paired with Daikin Communicating gas furnaces allowing for options of gas or heat pump heating to optimize operational costs based on changing utility costs.
6. The system shall be able to switch between heat pump heating and gas furnace heating at a field selectable change-over temperature which can be configured via condensing unit field settings.
7. Each system shall be able to enlarge from single to dual module without the need for installed main pipe size changes. The manufacturer shall provide predefined pipe sizes and design rules ensuring reliable system operation and offering design flexibility in phased installation applications.
8. Stable Operation – System shall provide stable inverter operation at varied ambient conditions.
9. No Drain Pan Heater – System shall be capable of heating operation without the need for a drain pan heater. If alternate manufacturer is chosen, an additional drain pan heater shall be provided by the manufacturer.
10. Auto Changeover – System shall, below the field selected outdoor ambient temperature provide signal to initiate auxiliary or back up heat.
11. Advanced Zoning - A single system shall provide for up to 64 zones.
12. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with up to 2000 positions for independent control.
13. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all "inverter" based flash vapor injection

compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.

- a. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.
14. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.
 - a. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.
15. Each system shall include a built-in data recorder that can store up to 45 minutes of operational data which can help identify the issue in case of a product failure
16. Heating during Defrost and Oil Return– 16 T and above VRF systems shall maintain continuous heating during defrost and oil return operation. Reverse cycle (cooling mode) in these modes shall not be permitted due to the potential reduction in space temperature.
17. Low Ambient Cooling - Each system shall be capable of low ambient cooling operation to -4°FDB (-20°CDB).
18. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve for independent control.
19. Flexible Design –
 - a. Systems shall be capable of up to 540ft (165m) [623 ft. (190m) equivalent] of linear piping between the condensing unit and furthest located indoor unit.
 - b. Systems shall be capable of up to 3,280ft (1,000m) total “one-way” piping in the piping network.
 - c. Single module systems (6 to 20 tons) shall have a vertical (height) separation of up to 361 ft between the condensing unit and the indoor units.
 - d. Systems shall be capable of up to 295ft (90m) from the first REFNET™ / branch point.
 - e. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.
 - f. Systems shall be capable of 98ft (30m) vertical separation between indoor units.
 - g. Condensing units shall be supported with a fan motor ESP up to 0.32” WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
20. Oil return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.
21. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.
22. Space saving – Each system shall not exceed the dimensions shown below

MODEL NUMBER	Dimensions in Inch (H x W x D)
REYQ168AATJ*	65-3/8 x 48-13/16 x 30-1/8

23. Each condensing unit shall include a multi-functional digital display that can provide system operation status such as operating refrigerant temperatures, pressures, outdoor electronic expansion valve opening and compressor operation time.

24. Each condensing unit shall include a service window that can provide easy access to system field settings and operation status without completely removing the condensing unit panel.
25. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.
26. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.
27. Advanced controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.
28. Each system shall be capable of integrating with open protocol BACnet, LonWorks and Modbus building management systems.
29. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).
30. The system shall be certified and listed in OSHPD directory for seismic certification
31. The condensing unit can be installed up to 200 ft above the ground without requiring any additional field modifications to the unit to comply with Miami Dade Wind code.
32. The condensing unit shall be factory equipped with Schrader valve for connection to a pressure relief kit for compliance with City of Chicago Pressure relief code.

C. PERFORMANCE:

1. The VRV REYQ_AA system shall perform as indicated in schedule
1. Performance Conditions:
 - a. Cooling: Indoor temperature of 80°FDB, 67°FWB and outdoor temperature of 95°FDB
 - b. Heating: Indoor temperature of 70°FDB and outdoor temperature of 5°FDB
 - c. Equivalent piping length: 25ft (7.5m)
2. Cooling or Cooling Dominant Operation:
 - a. The standard operating range in cooling or cooling dominant simultaneous cooling/heating will be 23°FDB ~ 122°FDB
 - b. Cooling mode indoor room temperature range will be 57-77°FWB
 - c. Each system as standard shall be capable of onsite reprogramming to allow low ambient cooling operation down to -4°FDB
3. Heating or Heating Dominant Operation:
 - a. The standard operating range in heating or heating dominant simultaneous cooling/heating will be -13° – 61°FWB
 - 1) If an alternate equipment manufacturer is selected, the mechanical contractor shall provide, at their own risk and cost, all additional material and labor to meet low ambient operating condition and performance
 - b. Heating mode indoor room temperature range will be 59°FDB - 80°F DB

2.03 EQUIPMENT

A. ELECTRICAL:

1. See equipment schedule for power supply requirements to the condensing unit.

WIRING:

2. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.

3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.
4. The control wiring maximum lengths shall be as shown below:

	CONDENSER TO INDOOR UNIT	CONDENSER TO CENTRAL CONTROLLER	INDOOR UNIT TO REMOTE CONTROL
CONTROL WIRING LENGTH	6,560ft (2,000m)	3,280ft (1,000m)	1640 ft. (500m)
WIRE TYPE	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

B. REFRIGERANT PIPING:

1. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units, without any oil traps or additional components.
2. REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.
 - a. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

C. PAINT/CORROSION RESISTANCE:

1. Paint and corrosion resistance shall be at a minimum per the table below:

COMPONENT	VRV EMERION		
	BASE MATERIAL	SURFACE TREATMENT	COATING THICKNESS
			External & Internal Surface
EXTERNAL PANEL BASE	Galvanized steel	POLYESTER	≥1.5 mils
EXTERNAL FRONT PANEL	Galvanized steel	POLYESTER	≥1.5 mils
PILLAR	Galvanized steel	POLYESTER	≥1.5 mils
COMPRESSOR COVER	ASTM material	Resin Paint	≥0.78 mils
FIN GUARD	Iron wire	Resin Paint	≥0.79 mils
FAN GUARD AND DRUM	Polypropylene	No treatment required	N/A
FAN	Acrylonitrile - glass	No treatment required	N/A
FAN MOTOR FRAME	Resin	No treatment required	N/A
FAN MOTOR SHAFT	Carbon steel	No treatment required	N/A
FAN MOTOR SUPPORT	Galvanized steel	POLYESTER	≥1.5 mils
HEAT EXCHANGERS (FIN ONLY)	Aluminum	Polymer Anti-corrosion surface treatment	Salt Spray 1000 hours, blister rating 10
ELECTRICAL PARTS BOX	Hot-dip zinc-coated steel	No treatment required	N/A
ELECTRICAL PARTS BOARD	Glass cloth / Glass nonwoven cloth material	Insulation Varnish	No specific thickness
SCREWS	Carbon steel wire rods	High corrosion resistance treatment	≥0.28 mils

2.04 OUTDOOR/CONDENSING UNIT

A. GENERAL:

1. The condensing unit is designed specifically for use with VRV series components.
2. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator.
3. High/Low pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.
4. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
5. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.

6. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
 7. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input.
 8. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
 9. The condensing unit shall be modular in design and should allow for side-by-side installation.
 10. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
 11. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
 12. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
 13. The condensing unit shall be capable of heating operation at -13°F (-25°C) wet bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
 14. 16 T and above VRV systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.
- B. UNIT CABINET:
1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.
 2. Each condensing unit shall have a three-segment panel design which allows for direct access to outdoor fans, critical mechanical and electrical components separately for ease of installation and service.
 3. Each outdoor unit shall have separate knock-outs for both refrigerant piping and wiring on the bottom panel

FAN:

4. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter. Reference table below.

MODEL NUMBER	FAN MOTOR OUTPUT (W) & QUANTITY
REYQ168AATJ*	650 x 2

5. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
6. The condensing unit shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.
7. Each outdoor unit fan shall be a vertical discharge configuration and the nominal airflow rate for each module will range from 6,200CFM to 14,505 CFM dependent on model specified.
8. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
9. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

C. SOUND:

1. Nominal sound pressure levels shall be as shown below.

MODEL NUMBER	SOUND PRESSURE LEVEL dB(A)
REYQ168AATJ*	65 dBA

2. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps.

OPERATION SOUND dB(A)	NIGHT MODE SOUND PRESSURE LEVEL dB(A) APPROX.
Level 1	55
Level 2	50
Level 3	45

D. CONDENSER COIL:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM B117 test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during operation enhancing the defrost operation.
 - a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

E. COMPRESSOR:

1. The Daikin inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
 - a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.
 - 1) Non –inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.
2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “P-type”.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
 - a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 1% to 100%.
5. The compressor's motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation.
9. In the event of compressor failure, the remaining compressors, if applicable, shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifold systems.
10. In the case of multiple condenser modules, combined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network.
11. Compressor configurations:

MODEL NUMBER	COMPRESSOR MOTOR OUTPUT (W)	QUANTITY	COMPRESSOR TYPES
REYQ168AATJ*	4090 + 6960	2	Inverter controlled

2.05 BRANCH SELECTOR UNITS

A. GENERAL:

1. MULTI-PORT FLEX BRANCH SELECTOR BOX SERIES

- a. The BSF6Q54TVJ IS designed specifically for use with VRV IV, VRV IV X, VRV EMERION VRV AURORA, and T-series Water Cooled heat recovery system components.
- b. These branch selector boxes shall provide individual control and changeover for multiple groups of indoor units.
- c. These branch selector boxes shall allow for Field selectable LEFT/RIGHT/PASS THROUGH piping configuration.
- d. These branch selector boxes shall allow multiple branch selector boxes to be connected downstream of the first Branch selector box in series in series.
- e. These Branch selector boxes when connected in series shall be able to support a total indoor load of up to 230MBH.
- f. The EEV heads and motors used in the branch selector box shall be accessible via a quick access panel without disassembly of the electrical box.
- g. The electrical box of the 4-port branch selector box shall be field re-locatable to left, right, and back side of the main cabinet.
- h. These branch selector boxes shall allow connected indoor units to operate in cooling mode down to -4F without any additional field installed accessories
- i. Labels shall be displayed close to the incoming 3 pipes to facilitate clear identification and eliminate cross piping.
- j. The branch selector boxes shall employ EEV with the ability to control up to 6000 pulses
- k. These selector boxes shall be factory assembled, wired, and piped.
- l. These selector boxes must be mounted indoors.
- m. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.

2. The number of connectable indoor units shall be in accordance with the table below:

BRANCH SELECTOR TYPE	MODEL NUMBER	MAXIMUM CONNECTABLE COOLING CAPACITY	MAXIMUM NUMBER OF CONNECTABLE INDOOR UNITS PER BRANCH
MULTI-PORT FLEX-SERIES	BSF4Q54TVJ	144,000 Btu/h*	5
	BSF6Q54TVJ	216,000 Btu/h*	5
	BSF8Q54TVJ	290,000 Btu/h*	5

* For multiple branch selector box connected in series, refer to the engineering manual for details.

B. UNIT CABINET

1. These units shall have a galvanized steel plate casing.
2. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch.
3. The cabinet shall contain one subcooling heat exchanger per branch.
4. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
5. Nominal sound pressure levels shall be measured and published on the submittals by the manufacturer. The sound levels must not exceed the values below.

- a. If an alternative manufacturer is selected, the mechanical contractor shall provide, at their own cost and expense, any additional material and labor to meet the below published sound levels

BRANCH SELECTOR TYPE	MODEL NUMBER	SOUND LEVEL dB(A) OPERATION	SOUND LEVEL dB(A) MAX
MULTI-PORT FLEX-SERIES	BSF4Q54TVJ	37	47
	BSF6Q54TVJ	40.5	50
	BSF8Q54TVJ	40.5	50

DIMENSIONS:

- b. The branch selector units shall not exceed dimensions stated in the table below.

BRANCH SELECTOR TYPE	MODEL NUMBER	HEIGHT Inches (mm)	WIDTH Inches (mm)	DEPTH Inches (mm)
MULTI-PORT FLEX-SERIES	BSF4Q54TVJ	9 -1/2 (241)	13-3/4 (348)	23-3/4 (603)
	BSF6Q54TVJ	9 -1/2 (241)	23-3/8 (593)	23-3/4 (603)
	BSF8Q54TVJ	9 -1/2 (241)	23-3/8 (593)	23-3/4 (603)

6. REFRIGERANT VALVES:

- The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.
- The refrigerant connections must be of the braze type.
- In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, redundancy must be provided.
- Multiple indoor units may be connected to a branch selector box with the use of a REFNET™ joint provided they are within the capacity range of the branch selector.
- These branch selector boxes shall support up to the maximum capacity per port shown in the table below

BRANCH SELECTOR TYPE	MODEL NUMBER	MAXIMUM CAPACITY PER PORT
MULTI-PORT FLEX-SERIES	BSF4Q54TVJ	54,000 Btu/h
	BSF6Q54TVJ	54,000 Btu/h
	BSF8Q54TVJ	54,000 Btu/h

CONDENSTATE REMOVAL:

- The unit shall be hermetically sealed to prevent condensation build up inside the unit, and not require use of a secondary condensate collection pan. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code, if an alternate manufacturer is selected.

7. ELECTRICAL:

- The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
- The unit shall be capable of operation within the limits of 187 volts to 255 volts.
- The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
- The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

PART 3 EXECUTION

1. EXAMINATION

- a. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.
- b. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- c. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.
- d. Proceed with installation only after unsatisfactory conditions have been corrected.

2. INSTALLATION

- a. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- b. requirements are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- c. Maintain manufacturer's recommended clearances for service and maintenance.
- d. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3. CONNECTIONS

- a. Comply with requirements for piping in other Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- b. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- c. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
- d. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

4. FIELD QUALITY CONTROL

- a. Perform tests and inspections.
 - 1) Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

b. Tests and Inspections:

- 1) Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
- 2) Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
- 3) Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
- 4) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 5) Verify proper airflow over coils.

c. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

d. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

e. Prepare test and inspection reports.

5. STARTUP SERVICE

a. Perform startup service.

- 1) Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for physical damage to unit casing.
2. Verify that access doors move freely and are weathertight.
3. Clean units and inspect for construction debris.
4. Verify that all bolts and screws are tight.
5. Adjust vibration isolation and flexible connections.
6. Verify that controls are connected and operational.

b. Lubricate bearings on fan motors.

c. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

d. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

e. Measure and record airflow and air temperature rise over coils.

f. Verify proper operation of condenser capacity control device.

g. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

h. After startup and performance test, lubricate bearings.

6. DEMONSTRATION

- a. Train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 236200

APPENDIX A

HVAC EQUIPMENT ALTERNATE (GENERAL INFORMATION)

- 1) The alternate equipment supplier shall provide to the bidding mechanical contractor a complete equipment data package.
 - a) This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions. Nominal performance data is not acceptable.
 - b) The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.
 - c) The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that that manufactures product may not be acceptable or approved.
 - d) All equipment must have visible and permanent label clearly identifying the original manufacturer of the equipment. These labels shall have original manufacturer's name and contact information and be located both inside and outside the equipment and on all equipment-related literature. Submittals shall include the above statement as confirmation by supplier that all conditions are agreed to and complied to. Failure to comply with these requirements shall be sufficient cause for rejection of the submittal and product with no further consideration.
- 2) The alternate equipment supplier shall furnish a complete drawing package to the mechanical contractor 15 days prior to bid day for bidding and installation.
 - a) The drawing format shall be .dxf or equivalent, on 30"x42" sheets.
 - b) The HVAC and electrical series design documents will be made available in electronic format for use by the equipment supplier in preparing their drawings.
 - c) The alternate equipment supplier shall prepare the following drawings:
 - i) XXX HVAC Floor Plan
 - ii) XXX HVAC Refrigerant Piping Plan
 - iii) XXX HVAC Refrigerant Piping/Controls Details
 - iv) XXX HVAC Details
 - v) XXX HVAC Schedules
 - d) The alternate equipment supplier shall draft all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system details and schedules for their system. The drawings shall convey all requirements to successfully install the alternate equipment suppliers system.
 - e) Provide (2) drawing package sets plotted on 20 lb. vellum. Provide (1) drawing package in electronic format (.dxf files) on CD.
 - f) The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.
- 3) The equipment supplier shall submit, as part of the equipment data package, condensing unit data sheets. Data sheets to include the following:
 - a) COOLING capacities at project design conditions:
 - i) Cooling (Btu/h)
 - ii) Cooling Input Power:
 - (1) Ducted (kW)
 - (2) Ductless (kW)
 - (3) Mixed (kW)
 - iii) Part Load IEER:
 - (1) Ducted

- (2) Ductless
 - (3) Mixed
- iv) SCHE
- v) Full Load EER:
 - (1) Ducted
 - (2) Ductless
 - (3) Mixed
- b) HEATING capacities at project design conditions:
 - i) Heating (Btu/h)
 - ii) Heating Input Power:
 - (1) Ducted (kW)
 - (2) Ductless (kW)
 - (3) Mixed (kW)
 - iii) Full Load COP @ 47°F:
 - (1) Ducted
 - (2) Ductless
 - (3) Mixed
 - iv) Full Load COP @ 17°F:
 - (1) Ducted
 - (2) Ductless
 - (3) Mixed
- c) The submitted capacity and efficiency performance must meet or exceed the listed performance on the schedule at the designed space conditions including de-rate factors for defrost if applicable and refrigerant piping losses.
 - i) OPERATING TEMPERATURE RANGE:
 - (1) Cooling
 - (2) Heating
 - ii) POWER SUPPLY:
 - (1) Maximum Circuit Amps (MCA)
 - (2) Maximum Overcurrent Protection Amps (MOP)
 - (3) Maximum Starting Current (MSC)
 - (4) Condenser Fan Motor
 - iii) REFRIGERANT:
 - (1) Refrigerant type and charge details including field charge for piping to ensure code compliance.
 - (2) Control of refrigerant temperature based on weather and load or alternative function.
 - iv) UNIT DATA:
 - (1) Max. number of indoor units
 - (2) Sound pressure level at 3ft (dBA)
 - (3) Weight (lbs)
 - (4) Dimensions
 - (5) Demand limit function description
 - (6) Details on sequential start functionality
 - (7) Coil anticorrosion data
- 4) The equipment supplier shall guarantee the performance of their system and all published data submitted. Performance shall be based on the design criteria below.
 - a) Room Temperature (Cooling)
 - b) Room Temperature (Heating)
 - c) Ambient Temperature (Summer)

- d) Ambient Temperature (Winter)
 - e) Defrost De-rate Factor
 - f) Refrigerant Piping Loss
- 5) The alternate equipment supplier shall submit with bid, indoor unit data sheets. Data sheets to include the following:
- a) Capacities at project design conditions:
 - i) Cooling (Btu/h)
 - ii) Cooling Input Power (kW)
 - iii) Part Load IEER
 - iv) SCHE
 - v) Full Load EER
 - vi) Heating (Btu/h)
 - vii) Heating Input Power (kW)
 - viii) Full Load COP@47°F
 - ix) Full Load COP@17°F
 - x) Air Flow (CFM)
 - b) External Static Pressure (ESP)
 - c) Electrical Data (MAC, MOP, MSC, RLA)
 - d) Weight (lbs)
 - e) Dimensions
- 6) The equipment supplier shall provide a certificate which states that the equipment has a minimum salt spray resistance of 1000 hours.
- 7) The equipment supplier shall submit the warranty certificate to the mechanical contractor.

END OF SECTION 23 81 29

SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes electric air coils that are not an integral part of air-handling units.

1.2 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 air coil. Include rated capacity and pressure drop for each air coil.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 ELECTRIC COILS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Brasch Manufacturing Co., Inc.
 - 2. Chromalox, Inc., Wiegand Industrial Division; Emerson Electric Company.
 - 3. Dunham-Bush, Inc.
 - 4. INDEECO.
 - 5. Trane.
- D. Coil Assembly: Comply with UL 1995.

- E. Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.
- F. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets.
- G. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.
 - 1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- H. Frames: Galvanized-steel channel frame, minimum 0.052-inch-thick for slip-in mounting.
- I. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
 - 1. Magnetic contactor.
 - 2. Mercury contactor.
 - 3. Toggle switches; one per step.
 - 4. Step controller.
 - 5. Time-delay relay.
 - 6. Pilot lights; one per step.
 - 7. Airflow proving switch.
- J. Refer to Division 23 Section "Instrumentation and Control for HVAC" for thermostat.
- K. Thermostats: Wall-mounted thermostats, with temperature range from 50 to 90 deg F, and 2.5 deg F throttling range.
- L. Capacities and Characteristics:
 - 1. Coil Face Dimensions:
See duct size on floor plan
 - 2. Mounting: slip in
 - 3. Air Side:
See scheduled for capacity & characteristics

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.

- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.
- E. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- F. Install piping adjacent to coils to allow service and maintenance.
- G. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Instrumentation and Control for HVAC" and other piping specialties are specified in Division 23 Section "Hydronic Piping."
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238216

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 WALL AND CEILING HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Berko Electric Heating; a division of Marley Engineered Products.
 2. Chromalox, Inc.; a division of Emerson Electric Company.
 3. Indeeco.
 4. Markel Products; a division of TPI Corporation.
 5. Marley Electric Heating; a division of Marley Engineered Products.
 6. Ouellet Canada Inc.
 7. QMark Electric Heating; a division of Marley Engineered Products.
 8. Trane.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- C. Cabinet:
1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.
- F. Fan: Aluminum propeller directly connected to motor.
1. Motor: Permanently lubricated multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
- G. Controls: Unit-mounted thermostat.
- H. Electrical Connection: Factory wire motors and controls for a single field connection.
- I. As indicated on the contract drawings

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 238239

DIVISION 26– ELECTRICAL

Section 26 00 20	Electrical Demolition	3
Section 26 05 00	Common Work Results for Electrical	7
Section 26 05 19	Low-Voltage Electrical Power Conductors and Cables	4
Section 26 05 26	Grounding and Bonding for Electrical Systems	4
Section 26 05 29	Hangers and Supports for Electrical Systems	3
Section 26 05 33	Raceways and Boxes for Electrical Systems	7
Section 26 05 53	Identification for Electrical Systems	5
Section 26 05 73	Power System Studies	6
Section 26 08 00	Electrical Commissioning	4
Section 26 09 23	Lighting Control Devices	8
Section 26 24 16	Panelboards	5
Section 26 27 26	Wiring Devices	4
Section 26 28 13	Fuses	1
Section 26 28 16	Enclosed Switches and Circuit Breakers	4
Section 26 43 13	Surge Protection for Low-Voltage Electrical Power Circuits	2
Section 26 51 10	Interior Lighting	5
Section 26 52 19	Emergency and Exit Lighting	3
Section 26 56 00	Sports Field Lighting	5
Section 26 56 10	Exterior Lighting	3

SECTION 26 00 20 – ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This section is a Division 26 Electrical Demolition section and is part of each Division 26 section.
- B. Drawings and General Provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections apply to work of this section including disposal requirements for hazardous material such as asbestos and PCB's.

1.2 SCOPE OF WORK

- A. The work under this section shall include providing all labor, equipment and materials of every kind necessary to complete the demolition of existing electrical systems as shown on the drawings and described herein.
- B. Demolition is to coincide with the phased construction described in the Division 01 documents. Portions of the facility are to be occupied and operational through portions of the renovation.
- C. Temporary wiring shall be provided as necessary for any occupied portion of the facility to remain in operation. See Division 01 specifications for additional information regarding demolition/construction scheduling requirements.
- D. The demolition drawings are intended to provide a representation of the magnitude and type of demolition required. Other hidden or un-shown demolition or temporary provisions may be required to accomplish the renovation process.
- E. Downtime shall be held to a minimum; outages shall be scheduled at a time acceptable to and approved by the Owner. This may require work involving power outages to be done at night, early morning or other non-standard hours.

1.3 DESCRIPTION OF WORK

- A. General Description Unless Otherwise Noted:
 - 1. Remove and dispose of all existing line voltage and limited energy electrical systems, fixtures and devices indicated for removal.
 - 2. Remove all wiring back to the panel source for existing circuits which are not to be removed or modified.
 - 3. Remove all exposed conduit, support brackets, hangers, etc. for circuits or feeders which are not to be reused or modified.
 - 4. Existing concealed conduits below grade or within unopened walls to remain: Remove boxes, wiring and abandon conduit.
 - 5. Electrical materials removed for re-installation or relocation shall be safely stored. This material is the contractor's responsibility to protect.
 - 6. Prior to demolition the Electrical sub-contractor shall tour the facility with the Demolition and General Contractors to identify and mark all materials that are intended for relocation. Prior to structural demolition, the Electrical Contractor shall remove all materials indicated for relocation at the appropriate time during demolition to ensure that it is not damaged. Material destroyed by demolition shall be replaced at no additional charge to the owner.
 - 7. The Electrical Contractor shall ensure that power has been turned off to all material being demolished with structure or ceiling prior to demolition work.
- B. Demolition Work:
 - 1. Demolition of electrical work shall be performed by the electrical contractor.

2. On existing walls or ceilings to remain, remove the existing light fixtures, receptacles, switches, disconnects, systems devices, surface conduit, surface raceway, wiring, boxes, LV devices, supports, brackets, hangers, etc. as indicated on the electrical demolition plan.
3. The electrical demolition plans show all existing electrical material to be removed but may not indicate associated boxes, raceway or other hardware. With the exception of 4" or smaller flush boxes serving devices or fixtures to be removed, all associated material shall be removed. Larger flush boxes or cabinets shall be cut out and the wall patched back to new "like kind" finish.
4. On walls, floors or ceilings which are to be removed, verify that all power is disconnected prior to demolition. Electrical on and within those structures may be removed for salvage or demolished with the wall structure.
5. Remove all existing low voltage cable installed in conduit and run open.
6. Electrical Panels and Services Equipment: All existing service and branch panels are to remain.
7. The Contractor shall disconnect power and remove all exposed conduit, disconnect switches, starters, etc., associated with mechanical equipment to be removed. Coordinate the extent of this work with Division 23 documents.
8. Contractor shall transport and legally dispose of off-site, all materials resulting from demolition not being salvaged. Refer to Division-01 specifications for disposal procedures involving hazardous materials.
9. Existing concealed conduit and wiring that serves equipment or devices to be removed may be re-used by the contractor provided it meets code and specification requirements and will not interfere whatsoever with the renovation work.

PART 2 - SALVAGE

2.1 SALVAGE

- A. Certain salvageable items will be removed by the Owner prior to awarding the contract, including some existing IT material and video surveillance cameras.
- B. The Owner shall have first salvage rights.
- C. Contractor Salvage: Items of salvageable value to Contractor which are not claimed by the Owner may be removed from the structure as work progresses. Contractor salvaged items must be transported from site as they are removed. Storage or sale of removed items on site will not be permitted.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Condition and Premises: The Owner assumes no responsibility for the actual condition of premises to be demolished. Owner will maintain general conditions existing at time of inspection for bidding purposes.
- B. Protection: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons.
- C. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to the Owner.
- D. Patch and Repair: Openings left by the removal of electrical equipment or conduit shall be infilled, patched and repaired to meet Division 01 requirements.

- E. Coordinate all demolition work and scheduling with the General Contractor and school district's construction manager.
- F. Equipment demolition shall include removal of all exposed connecting conduit, surface raceways, outlet boxes, etc., either to a point below floor, behind wall surface, etc.
- G. The cost of patching and repairing all walls, ceilings and floors, which are to remain and are damaged, cut, drilled or altered for the installation or removal of electrical work, is the responsibility of Division 26. Repair work is to be performed by and paid for under Division 26. All work to meet Division 01 requirements.
- H. Abandoned Conduit: Cut and remove raceway and wiring to a minimum depth of 2 inches (50 mm) below the surface of adjacent construction. Cap and patch surface to match existing finish. All abandoned circuits that are not concealed are to be removed.
- I. Remove all existing surface conduits, raceways and equipment serving equipment which is not to remain, within demolition areas. Not all existing surface raceways are indicated on the drawings. The Contractor shall tour site and determine the cost for removal of existing surface items and include that cost as part of the bid.
- J. Where existing flush boxes remain on walls which are not to be removed, furred out or covered, provide blank plates as follows:
 - 1. Standard device gang (1, 2, 3 etc.) boxes: Provide nylon ivory blank cover plates. Utilize jumbo plates where necessary to cover masonry rough openings.
 - 2. Non-standard boxes (clock, timers, relays, etc.): Provide custom made solid 14 gauge steel covers. Installed prior to room finish painting

3.2 LAMP & BALLAST DISPOSAL

- A. Any lamps that are removed from existing fixtures shall be properly disposed of or recycled through an approved lamp recycler. Contractor shall contact the local jurisdiction for acceptable lamp disposal. Projects within Washington State shall comply with the Universal Waste Rules for Dangerous Work Lamps WAC 173-303-573. All lamp disposal shall be considered inclusive in the contract.
- B. Any ballasts containing PCBs shall be disposed of in accordance with the Hazardous Materials provisions in the Division 01 specifications.

END OF SECTION 26 00 20

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Common electrical installation requirements.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.

1.2 COMMON ELECTRICAL INSTALLATION REQUIREMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this Section. Applicable Drawings and Technical Specifications herein shall be taken together as one and shall apply and be used in conjunction with Work under this Division 26- "Electrical Specification" and other published Divisions. Comply with these and other Divisions which affect electrical work for requirements of insurance, as-built drawings, shop drawings, permits, guarantee, maintenance manuals, substitutions, etc.
- B. This section specifies the general requirements for Electrical work. Detailed requirements for specific electrical items are specified in other sections and are subject to the general requirements in this section. Provide all electrical labor and materials required for installation as indicated in the drawings and the specifications. All incidental & other materials and labor not specifically called out but that are required to provide a complete and operable electrical installation in accordance with the contract shall be provided. Provide same brand, device, model, or manufacturer for all similar devices or equipment where multiples occur.
- C. Coordinate work under this division with all other work under Contract, including work provided by the Owner's forces. Work also includes conduit/raceway, wiring, and terminations, performed to Division-26 standards, required for electrical equipment furnished under other Division Sections. Contractor is responsible for determining scope of electrical work requirements within other published Division Sections, whether such work is coordinated or indicated on Division-26 documents. Coordinate location of equipment and devices to avoid conflicts with other work. Plan the work ahead of schedule and verify electrical requirements, connections and interface with other trades. Coordinate the installation work to eliminate or minimize cutting and patching. Carefully examine the full set of Contract documents for electrical work and requirements. Extra cost will not be allowed if electrical work is required to be moved due to interference with other work. Extra cost will not be allowed for electrical work indicated in the Contract documents. If other Trades relieve the electrical contractor of any portion of this work, copies of the Release containing a complete and accurate description of the cables and conduits retained by the other Vendor or Trade shall be forwarded to the ARCHITECT/ENGINEER by Transmittal Letter.
- D. All bids, take-offs, or quotes, including those by "Subs", shall be based upon & performed upon entire set of Contract Documents (CD) and physical site walk-through visit, if required. Do not perform bids, take-offs, or quotes with incomplete or partial sets of CD's. Contractor is responsible for determining any Subcontractor scope and contractual requirements, Work, and supervision for Subcontractors, if any. Electrical Contractor who performs this Division's work shall be responsible to the General Contractor; the General Contractor has final responsibility for this work under this Division. Contractors bidding project for work under this Section must comply with Divisions 0 & 1 bidding stipulations and arrive at all bid amounts confidentially & independently in a competitive manor.

- Do not unlawfully disclose bids prior to bid opening. Do not improperly influence any party in restricting competitive bids.
- E. By submission of its bid, this Contractor acknowledges that Contractor has examined the plans, specifications, and site to satisfaction for Work under this Division, and this Contractor acknowledges that it has prepared its bid based on full and adequate knowledge of all contract agreements & terms, including price, payment provisions, delivery terms, quantity, quality, and schedule of work required for receipt, storage and protection, installation, and checkout and start-up of affected apparatus items.
 - F. Bring questionable, obscure items, apparent conflicts between contract drawings, specifications, governing codes, or utilities regulations, to the attention of the Architect during bidding period. After contract award, notify the ARCHITECT/ENGINEER in accordance with General Provisions.
 - G. All proposed substitutions from those shown or specified shall be received by the Engineer at least 10 days prior to Bid. Priors received after 3 p.m. of the 10th prior day will be rejected. Contractor shall supply specific burden-of-proof of equal performance & appearance with documentation such as technical data, calculations, performance, photometric and dimensional "to-scale" cut-sheets or drawings demonstrating or showing that the proposed substitutes are equal to product specified and specifically highlighting any difference. Faxed prior approvals will not be accepted. Subsequent performance, appearance or fit issues of substituted item, even if approved, apart from or different than originally specified item, not brought to the direct attention of the Engineer-of-Record prior to bid, which require additional engineering design work, those additional costs (at prevailing rates) shall be bore solely by the awarded Contractor submitting substitution.
 - H. Contractor shall submit, in writing, an RFI, for any apparent or perceived discrepancy, omission, question, conflict or misunderstanding between Contract, Drawings, Codes, Plans, and/or Specifications, prior to submitting bid. Note: The more stringent interpretation may apply; therefore the Contractor shall bid the more stringent provisions or requirements, unless the discrepancy is properly addressed prior to bid. Absence of such written RFI prior to bid shall indicate Contractor has included all provisions in its proposal and/or bid.
 - I. All electrical associated and/or related Work described herein is deemed technical in nature and contractor shall make allowances thereof and shall be performed by certified and qualified electricians, and their direct reports, while employed and under direct supervision of and by State Licensed "Unlimited" Electrical Contractor, in State which Project is located, which requires a Master Electrician of Record, & Bonded per Division 0-"Contract" specifications, and be familiar & experienced with such Work indicated herein, & qualified by most recent OSHA certification to work on energized equipment. Refer to & comply with OSHA 29CFR.1910 & 1926 electrical safety portions. Contractor and direct reports shall have obtained/be current and be deemed "qualified person" per 29 CFR 1910.332(b)(3). Contractor is responsible for determining safety requirements. All electrical related work shall be performed during proven de-energized conditions including lock-out/tag-out methods whenever possible. Assumed condition is "Energized" until proven otherwise. Contractor is responsible for determining construction method and means (M/M) and M/M requirements. Contractor shall provide Work within standard of care for profession. Contractor is responsible for field-determinations pertaining to continued use or suitability of equipment for a specific or intended purpose, environment, or application.
 - J. TECHNICAL DEFINITIONS or TERMS – Shall be applied, interpreted, understood, and as defined by NEC Article 100, most recent applicable edition.
 - K. Engineer has no responsibility or professional liability and does not represent safeguards or code compliance and does make any express warranty pertaining

to or on any plan or portion thereof which was prepared or designed by third parties or others which relates to the electrical plans set of construction documents. Where AHJ in the exercise of official duties presents subsequent approvals, or which approvals are subject to, which contain or make changes to otherwise, in the judgment or opinion of the engineer, code-conforming conditions, directions, or recommendations per plans with which the Contractor complies, AHJ accepts and becomes fully responsible for impacts due to those changes.

1.3 CODES, STANDARDS, MATERIALS, AND FEES

- A. All labor, work and materials provided shall comply with latest (most recently approved) rules and regulations, as modified by WAC-296-46B, of the following standards and codes:
 - 1. National Electrical Code (NFPA 70)
 - 2. Applicable NFPA Publications
 - 3. Applicable IFC Publications
 - 4. Applicable IBC Publications
 - 5. Applicable OSHA Publications
 - 6. Applicable ANSI, ASHRE, UL, NECA and NEMA Standards
 - 7. Requirements of Local Utility
 - 8. Additional Codes and Standards stated in Subsequent Specification sections.
- B. If any conflict occurs between these rules and the drawings and specifications, the rules are to govern. This does not relieve the contractor of complying with any additional requirements as defined by the engineer concerning the plans and specifications which are by design above or in excess of the codes and regulations. If any conflict occurs between General Specification or General Note and a subsequent Specific Specification or Specific Note; the Specific shall prevail, providing code minimums are complied with.
- C. All equipment and materials supplied for this job are to be new & NRTL listed or equivalent with material displaying the appropriate NRTL label. If NRTL labeling is not available for the type of product it shall be specifically noted within the submittals or identified in writing to the Engineer. All equipment and materials shall be installed in strict accordance with Manufacturer's instructions. The voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is intended.
- D. Contractor shall obtain and pay for all permits and fees required by any government agency having jurisdiction over the work and shall arrange all inspections required by these agencies. Contractor shall notify Owner via General Contractor in writing, within 3 days of inspection, the results of all inspections; including rough in and final. Where Contractor and AHJ make special limited arrangements by permission to document by photograph certain areas intending to be covered-up without inspection; these photographs shall become part of and included within the project "as-built" records and shall include date and brief description.
- E. The contractor shall include in their bid all utility company fees for temporary service work related to the project in their bid. Utility company fees for permanent power and communications shall be paid for by the owner.

1.4 ELECTRICAL DRAWINGS

- A. Electrical Drawings are diagrammatic and are not intended to show all features of work. Contractor shall provide all peripherals and make minor adjustments in order to achieve a complete, working system at no additional cost to Owner.
- B. Install electrical items in a manner to provide symmetrical appearance where not dimensioned on Drawings. Do not scale Drawings for equipment location. Review drawings prepared by other disciplines and adjust work to conform to

conditions show. Data presented on Drawings are as accurate as planning can determine. Dimensional accuracy is not guaranteed and field verification of dimensions, locations, and levels to suit field conditions is required.

1.5 SHOP DRAWINGS AND SUBMITTALS

- A. Submittal documents shall be submitted by the contractor in electronic PDF format, with each specific section submitted as an individual PDF document and named to identify section and content (i.e. 262416 Panelboards); physical copies are not acceptable. The engineer's review of submittals does not relieve the contractor of responsibility to comply with the contract documents and/or governing codes and standards and shall not be construed as authorizing any deviations from the specifications or drawings unless contractor attaches a letter clearly listing the deviation. The burden of proof of equality (see plans or specification section showing "or equal", or "as approved", or "approved equal"), for permitted substitute equipment or materials complying with the specification, is the responsibility of the contractor. Deviations or substitutions from specified requirements not specifically noted in the shop drawings submittals do not constitute an acknowledgment or authorization for such substitution or occurrence unless the said deviation is specifically separately approved (or has prior written approval) in writing and is specifically noted in the submittal.
- B. Shop drawings, catalog sheets, specification sheets and descriptive material shall be submitted in electronic PDF format and be organized and referenced to the applicable specification section. These submittals shall be reviewed by the contractor and stamped approved prior to forwarding for review by the Engineer. Submittals received without contractor's signed note of approval will be subject to return without review. Submittals of individual or piecemeal items will not be accepted unless specifically arranged beforehand with the Engineer.
- C. Engineering shop drawing and/or submittal review, subsequent to General Contractor's approval, is not conducted for the purpose of determining the accuracy and/or completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems. Engineer's review only determines whether the shop drawing and/or submittal generally comply with the information or requirements stated in the contract documents. Shop drawing and/or submittal review by the engineer does not guarantee that the Contractor would perform in accordance with the contract requirements. Shop drawing and/or submittal review by the engineer does not relieve the Contractor of any contract document requirements. Do not submit to Engineer, methods or means of construction or safety related items.
- D. The Architect and Engineer's review of the submittals and shop drawings is intended as a check for general conformance with the contract documents only. Failure by the Architect or Engineer to identify an error in the submittal package does not relieve the contractor of the responsibility for compliance with requirements of the drawings, specifications, and applicable codes.
- E. Submittals on equipment and material shall include: catalog sheets, listing agency ratings, specification sheets, wiring and connection diagrams, layout and dimensions, descriptive material, performance data, operation description and any other data required to show compliance with contract documents. Where manufacturer's catalog cut-sheets show more than one model, configuration or part number; the submittal shall indicate which specific configuration is being submitted including finishes, relay-control options and the like and such submittal shall directly relate to plans identifier (i.e. Light fixture type "R60" or Panel "LDP").
- F. Contractor shall supply submittals (see respective specification sections for additional requirements) on the following items:
 - 1. Panelboards & Overcurrent Devices
 - 2. Receptacles and Switches

3. Disconnect Switches
4. Light Fixtures & Drivers/Emergency Drivers
5. Lighting Control System and Devices
6. Communication cables, racks, patch panels & device plates
7. Intercom and Clock System
8. Fire Alarm System
9. Security System
10. Product Data: For sleeve seals.

1.6 MATERIALS

- A. All materials supplied for this job are to be new & NRTL listed or equivalent with material displaying the appropriate NRTL label. If NRTL labeling is not available for the type of product it shall be specifically noted within the submittals or identified in writing to the Engineer. All equipment and materials shall be installed in strict accordance with Manufacturer's instructions. The voltage rating of electrical equipment shall not be less than the nominal voltage of a circuit to which it is intended.
- B. Provide all electrical labor and materials required for installation as indicated in the drawings and the specifications. All incidental & other materials and labor not specifically called out but that are required to provide a complete and operable electrical installation in accordance with the contract shall be provided. Provide same brand, device, model, or manufacturer for all similar devices or equipment where multiples occur.

1.7 MANUFACTURER'S WARRANTIES

- A. In the event of equipment or component failure during the warranty period, it is the Contractor's responsibility to repair or replace such defective equipment or components and bear all associated costs. The Contractor shall pursue manufacturer's warranties to the extent necessary to obtain replacement equipment and provide proof of action taken upon request. Assist Owner as directed in determining cause of failure. Each piece of equipment shall meet performance specifications for at least one (1) year of actual operation subsequent to substantial completion.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to or more than 50 inches and 1 or more sides equal to or more than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-

inchannular clear space between pipe and sleeve for installing mechanical sleeve seals.

- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Metal-clad cable, Type MC, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 260553 "Identification for Electrical Systems"
 - 2. Section 271000 "Structured Cabling Cat-6" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

- A. Submit data under provisions for Division 01.
- B. Product Data: For each type of product. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction and marked for intended use.
- B. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. RoHS compliant.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:
 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.
- G. Armor: Galvanized steel or aluminum, interlocked.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section. Thomas Betts or approved equal.
 1. Material: Copper.
 2. Type: Two hole with long barrels.
 3. Termination: Compression or Mechanical.
- D. Motor connections: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.
- E. Wet or exterior: Spring wire connectors, pre-insulated "twist-on", resin filled, rated for direct burial per UL 486D.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Branch Circuit and Feeder color code:
 1. Color code conductors by line or phase as follows:
 - a. Black, red, blue and white for 120/208V systems.
 - b. Brown, orange, yellow and gray for 277/480V systems.
 2. Conductors 6 AWG and smaller shall have colored insulation.
- B. Feeders: Copper for feeders smaller than 1/0 AWG; copper for feeders 1/0 AWG and larger.
- C. Branch Circuits: Copper, solid for No. 10 AWG and smaller, stranded for No. 8 AWG and larger. Aluminum conductors not approved for use in branch circuit wiring.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- D. Feeders Underground: Type XHHW-2, single conductors in raceway.
- E. Feeders in Cable Tray: Power conductors not approved for use in cable tray on this project.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2 or XHHW-2, single conductors in raceway.

- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC, except home runs which shall be Type THHN/THWN-2 or XHHW-2, single conductors in raceway.
- H. Branch Circuits Underground: Type XHHW-2, single conductors in raceway.

3.3 GENERAL WIRING METHODS

- A. Minimum No. 12 AWG conductors for power and lighting circuits.
- B. Minimum No. 18 AWG conductors for control wiring.
- C. Use No. 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- D. Make conductor lengths for parallel circuits equal.
- E. Do not share neutral conductors. Provide a dedicated neutral conductor for each branch circuit that requires a neutral.
- F. Place an equal number of conductors for each phase of a circuit in same raceway or cable.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Pull all conductors into a raceway at the same time. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Do not exceed manufacturer's recommended pull tensions.
- D. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely damage conductors has been completed.
- E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- H. Neatly train and lace wiring inside boxes, equipment and panelboards.
- I. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems." Do not support cables from ceiling suspension system.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Splice only in accessible junction or outlet boxes.
- C. Stranded wire shall not be wrapped around screw terminals.
- D. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- E. Splices, taps and terminations shall be made to carry the full ampacity of the conductors without perceptible temperature rise.
- F. Control system wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.
- G. Code sound and signal system wiring and any special equipment in accordance with manufacture's diagrams or recommendations.
- H. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

- 3.6 IDENTIFICATION
 - A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- 3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
 - A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 3.8 FIRESTOPPING
 - A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."
- 3.9 FIELD QUALITY CONTROL
 - A. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.
 - B. Torque conductor connections and terminations to manufacturer's recommended values.

END OF SECTION 26 05 19

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Test Reports:
 - a. The results of a 3-point fall of potential ground resistance test, performed on the installed grounding system shall be submitted.
 - b. Each test report shall include
 - 1) Date of test, soil moisture content and soil temperature.
 - 2) Test operator.
 - 3) Instrument or other test equipment used.
 - 4) Electrode designation or location matching that shown on shop drawings.
 - 5) Ground impedance in ohms.
 - 6) Assumptions made, if required.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Grounding Conductors: Copper conductor bare or green insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bonding Conductors: Solid bare copper wire for sizes 8 AWG and smaller diameter. Stranded bare copper wire for sizes 6 AWG and larger diameter. Conductors may be insulated if provided with green insulation.
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. Welding procedure shall include the proper mold and powder charge.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- K. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel 3/4 inch diameter by 10 foot length.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Distribution Transformer: Install grounding electrode(s) at the transformer location. The electrode shall be connected to the equipment grounding conductor on the secondary side of the transformer and the frame.

3.4 EQUIPMENT GROUNDING

- A. Install a separate, insulated equipment-grounding conductor in all feeder and branch circuits. The use of conduit (raceway) systems as an equipment ground path is not allowed. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on a single lug is not permitted. Each grounding conductor shall terminate on its own terminal lug.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or 12 inches below finished grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each above ground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify ARCHITECT/ENGINEER promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Support for conductors in vertical conduit.
 - 4. Structural steel for fabricated supports and restraints.
 - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Coordinate size, shape and location of concrete pads with Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. ERICO International Corporation.
 - d. Substitutions: per Division 01.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel
 - 4. Channel Width: Selected for applicable load criteria
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.
- 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES
 - A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
 - B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.
- 2.3 CONCRETE HOUSEKEEPING PADS
 - A. Concrete shall meet the requirements of Division 03, 'Cast-in-Place Concrete'.
 - B. Concrete housekeeping pads; 4-inch minimum nominal thickness.
- 2.4 CONCRETE BASES
 - A. Concrete pole bases may be pre-cast or field constructed in accordance with the drawing details.
 - B. Construct concrete bases of dimensions indicated but not less than 4-inches larger in both directions than supported unit and so anchors will be a minimum of 10 bolt diameters from edge of the base.
 - C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement required are specified in Division 03 Section "Cast-in-Place Concrete".

PART 3 - EXECUTION

- 3.1 APPLICATION
 - A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 105.
 - B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
 - C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, conduit or ceiling suspension system.
- F. Provide one seismic support wire for all fixtures weighing less than 10lbs, two minimum dedicated seismic support wires for each ceiling-mounted light fixture weighing less than 50lbs. Attach support wirings to building structure independent from ceiling system and on opposing corners of the light fixture to not allow fixtures to drop more than 6 inches upon ceiling failure. Provide four supports for fixtures > 50lbs.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
 - 2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, inner duct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Rigid Metal Conduit (RMC, GRC): Comply with ANSI C80.1 and UL 6.
 - 3. Intermediate Metal Conduit (IMC): Comply with ANSI C80.6 and UL 1242.
 - 4. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
 - 5. Electrical Metallic Tubing (EMT): Comply with ANSI C80.3 and UL 797.
 - 6. Flexible Metal Conduit (FMC): Comply with UL 1; galvanized or zinc-coated flexible steel, full or reduced wall thickness.
 - 7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 3. Fittings for EMT:
 - a. Material: Steel malleable iron.
 - b. Type: Setscrew or compression.
 - 4. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 5. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 1. Rigid Nonmetallic Conduit (RNC): Schedule 40 PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated. Provide PVC-coated rigid steel factory elbows for bends in all plastic conduit runs, regardless of length.
 - 2. LFNC: Comply with UL 1660.
- B. Nonmetallic Fittings:
 - 1. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - 3. Fittings for LFNC: Comply with UL 514B.
 - 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Square D.
 - 4. Substitutions under provisions of Division 01.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Cover: Screw cover.
- E. Finish: Rust inhibiting primer coat with gray enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy iron or copper-free cast aluminum Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized cast iron or copper-free aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4-inches square by 2-1/8 inches deep
- I. Gangable boxes are prohibited.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Oldcastle Precast, Inc.
 - b. Quazite: Hubbell Power Systems, Inc.
 - c. Substitutions under provisions of Division 01.
 2. Standard: Comply with SCTE 77.
 3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, "LIGHTING".

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: RMC or IMC.
 2. Concealed Conduit, Aboveground: RMC or IMC.
 3. Underground Conduit: RMC or RNC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
 1. Exposed, Not Subject to Physical Damage: IMC, RMC or EMT.
 2. Exposed and Subject to Physical Damage: RMC or IMC. Raceway locations include but are not limited to the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: IMC, RMC or EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: RMC or IMC.

6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in kitchens and damp and NEMA 250, Type 4X in damp or wet locations.
- C. Minimum Raceway Size:
 1. Below Grade: 1-inch minimum, unless otherwise noted.
 2. Above Grade: 1/2-inch minimum.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, steel or malleable iron fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motors and equipment connections and in Mechanical, Electrical, and Telecom equipment rooms. Do not route conduits on roofs, outside of exterior walls or along the surface of interior finished walls unless specifically noted on the plans.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 degrees F

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any mobile walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and hot-water pipes. Install horizontal raceway runs above water piping.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 1-inch of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC or IMC before rising above floor.
- L. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- S. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 degrees F and that has straight-run length that exceeds 25 feet.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
 3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semi-recessed luminaires, equipment

subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage and wet locations.
- U. Provide electrical boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.
 - V. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaires. Coordinate locations and sizes of required access doors with Division 08.
 - W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
 - X. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
 - Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
 - Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - AA. Locate boxes so that cover or plate will not span different building finishes.
 - BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
 - CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - DD. Align wall-mounted outlet boxes for switches, thermostats and similar devices.
 - EE. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.
 - FF. Orient boxes to accommodate wiring devices as specified in Section 262726.
 - GG. Unless otherwise noted, locate outlet boxes for light switches and lighting control stations within 6 inches of the door jamb on the latch side of the door.
 - HH. Provide knockout closures for unused openings.
 - II. Do not install flush-mounted boxes back-to-back in walls. Install with minimum 6-inch separation.
 - JJ. Do not fasten boxes to ceiling support wires or other piping systems.
 - KK. Provide blank covers or plates for all boxes that do not contain devices.
 - LL. Use protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.
 - MM. Use conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.
 - NN. Paint all exposed conduit to match the surface to which it is attached or crosses. Clean conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors and walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment.
 - a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."
6. Damage to existing underground utilities shall be repaired immediately by the Contractor at no cost to the Owner.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Comply with NFPA 70E Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- B. Equipment Identification Labels:
 - 1. Nameplate, black letters on a white field, with the following information.
 - a. Switchboards and Panelboards:
 - 1) Equipment designation.
 - 2) Source from which equipment is fed.
 - 3) Voltage, phase and wire configuration.
 - 4) AIC rating.
 - b. Disconnects, Starters or Contactors.
 - 1) Load served.
 - 2) Panelboard circuit number from which device is fed.

- 3) Fuse or circuit amperage and poles. Where fused disconnect is installed, denote the maximum fuse size to be installed.
- c. Control or Low-Voltage System Panels
 - 1) Equipment designation
 - 2) System description (fire alarm, intercom, security, etc.)
 - 3) Panelboard and circuit number from which panel is fed, if applicable.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.

- c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- d. Red, 6-inch wide, suitable for conductive or inductive tracing for locates.
- 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

2.6 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inches
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Service Disconnect Nameplate: Provide nameplate on service disconnect that reads "SERVICE DISCONNECT".
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage.
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
 - 1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 - 2. Install underground-line warning tape for cables in raceways.
- W. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- X. Metal-Backed Butyrate Signs:
 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- Y. Laminated Acrylic or Melamine Plastic Signs:
 1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- Z. Cable Ties: General purpose, for attaching tags, except as listed below:
 1. Outdoors: UV-stabilized nylon.

3.2 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.
- E. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- F. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated.
- G. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- H. Arc Flash Warning Labeling: Self-adhesive labels.
- I. Equipment Identification Labels:
 1. Indoor Equipment: Baked-enamel signs.
 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 26 05 53

SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Short-circuit study.
- B. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.

1.2 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 2416 - Panelboards.
- C. Section 26 2817 - Enclosed Circuit Breakers.
- D. Section 26 2818 - Enclosed Switches.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
- B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaff 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata, 2003.
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations; 2002, including 1584a (2004) and 1584b (2011) amendments.
- G. NEMA MG 1 - Motors and Generators; 2014.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect/Engineer.

3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Field testing agency's qualifications.
- D. Study reports, stamped or sealed and signed by study preparer.
- E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 1. Include characteristic time-current trip curves for protective devices.
- F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- G. Site-specific arc flash hazard warning labels.
- H. Field quality control reports.
- I. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- J. Project Record Documents: Revise studies as required to reflect as-built conditions.
 1. Include hard copies with operation and maintenance data submittals.
 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.6 POWER SYSTEM STUDIES

- A. Scope of Studies:
 1. Perform analysis of new electrical distribution system as indicated on drawings.
 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
 - a) Known Operating Modes:
 - 1) Utility as source.
 - 2) Generator as source.
 - 3) Maintenance settings.
- B. General Study Requirements:
 1. Comply with NFPA 70.
 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.

- a) Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
- 1) Obtain up-to-date information from Utility Company.
- 2) Utility Company: As indicated on drawings.
 - b) Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - c) Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - d) Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
- D. Short-Circuit Study:
 - 1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
 - 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a) Maximum utility fault currents.
 - b) Maximum motor contribution.
 - c) Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 - 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Arc Flash and Shock Risk Assessment:
 - 1. Comply with NFPA 70E.
 - 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 - a) To clarify IEEE 1584 statement that "equipment below 240 V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply" for purposes of studies, study preparer to include equipment rated less than 240 V fed by transformers less than 125 kVA in calculations.
 - b) Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
 - c) For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584, yielding conservative results.

3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a) Maximum and minimum utility fault currents.
 - b) Maximum and minimum motor contribution.
 - c) Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

F. Study Reports:

1. General Requirements:

- a) Identify date of study and study preparer.
- b) Identify study methodology and software product(s) used.
- c) Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
- d) Identify base used for per unit values.
- e) Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
- f) Include conclusions and recommendations.

2. Short-Circuit Study:

- a) For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.
- b) Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.

4. Arc Flash and Shock Risk Assessment:

- a) For each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
- b) For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
- c) Identify locations where the calculated maximum incident energy exceeds 40 calories per sq. cm.
- d) Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in

the preparation of studies of similar type and complexity using specified computer software.

1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 1. Acceptable Software Products:
 - a) EasyPower LLC: www.easypower.com.
 - b) ETAP/Operation Technology, Inc: www.etap.com.
 - c) Power Analytics Corporation: www.poweranalytics.com.
 - d) SKM Systems Analysis, Inc: www.skm.com.

PART 2 PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 1. Materials: Comply with Section 26 0553.
 2. Minimum Size: 4 by 6 inches (100 by 150 mm).
 3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - b) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - c) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
 - d) Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.
 - 6) Restricted approach boundary.
 - 7) Equipment identification.
 - 8) Date calculations were performed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 26 0553.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.

- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Adjust equipment and protective devices for compliance with studies and recommended settings.
- E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.
- F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.3 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION 26 05 73

SECTION 26 08 00 ELECTRICAL COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to describe the commissioning process specific for those sections found in Division 26.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. General Responsibilities: The Contractor's commissioning responsibilities applicable to each of the electrical contractor is as follows (all references apply to commissioned equipment only):
 - 1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - 2. Attend a commissioning kick-off meeting and other meetings necessary to facilitate the Commissioning process.
 - 3. Contractors shall assist in clarifying the installation, operation, maintenance, and control of commissioned equipment if requested by the Commissioning Authority.

- B. COORDINATION

- 1. Refer to Section 01 91 13 for a listing of all sections where commissioning requirements are found, for systems to be commissioned and for Pre-verification testing requirements.

1.3 SUBMITTALS

- A. General Submittals: Contractor shall provide to the Commissioning Authority, through established channels, normal cut sheets and shop drawing submittals, and manufacturer's installation and start-up checklists, for all commissioned equipment.
- B. Aid the Commissioning Authority in preparation of the specific functional performance test procedures specified in Section 019113. Subcontractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 STARTUP

- A. General Requirements:
 - 1. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Electrical Contractor:

1. The electrical contractors shall follow the Project start-up plan outlined in 019113. Division 26 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning authority or Owner.

3.2 Pre-Verification Testing (PVT): The Contractor will perform the Pre-verification tests as provided with the Facility Grid app. When all pre-verification testing has been completed, the CA will schedule Functional Performance testing and substantial completion may be issued.

3.3 Functional Performance Testing:

- A. Functional Performance testing is intended to begin upon completion of a system. Functional Performance testing may proceed prior to the completion of systems or sub-systems at the discretion of the Owner's Representative and Commissioning Authority. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all construction checklists and Pre-verification tests as soon as possible.

3.4 Deferred Testing

- A. Assist with seasonal or deferred functional performance testing as needed.
- B. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

3.5 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver to the Contractor for inclusion in the O&M manuals, according to Division 1. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
- B. During construction, maintain as built redline drawings for all drawings and final as-built for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare redline as-built drawings for all drawings and final as-built for contractor-generated coordination drawings.
- C. The Commissioning Authority shall receive a copy of the O&M manuals for review and approval.

3.6 Training

- A. The Owner personnel shall be trained on procedures related those listed for Division 26.
 1. Provide Training checklists for each session and specification section and/or subject.
 2. Prerequisites and Agenda must be complete before training can begin.
 - a. Training shall start with classroom sessions, if necessary, followed by hands on training on each component, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

- b. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - c. The appropriate trade or manufacturer's representative shall provide the instructions on each major component. This person may be the start-up technician for the component, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific component is required. More than one party may be required to execute the training.
 - d. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
2. Training shall include:
- a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance; special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 - c. Discuss relevant health and safety issues and concerns.
 - d. Discuss warranties and guarantees.
 - e. Cover common troubleshooting problems and solutions.
 - f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discuss any peculiarities of equipment installation or operation.
 - h. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.
 - i. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and maintenance of all pieces of equipment.
 - j. Training shall occur after functional testing is complete, unless approved otherwise by the Owner's Representative and Commissioning Authority.
 - k. Deferred training will follow the same outline as above.
3. Duration of Training: The appropriate contractor shall provide training on each component as required in the main specifications. The electrical contractor shall have the following training responsibilities:
- a. Provide the Owner's Representative and Commissioning Authority with a training plan and training checklists two weeks before the planned training according to the outline described in Division 1.

- b. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
- c. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls.

3.7 DOCUMENTS REQUIRED

- A. The General Contractor will provide the following documentation before Final Acceptance:
 - 1. Completed Inspection Forms with approval signatures of all Authority Having Jurisdiction.
 - 2. Approval Signature of Electrical Engineer

END OF SECTION

SECTION 26 09 23 - ADDRESSABLE LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work specified in this section.
- B. Related Requirements:
 - 1. Section 019100 – General Commissioning Requirements
 - 2. Section 260500 – General Provisions for Electrical Systems
 - 3. Section 260553 – Identification for Electrical Systems

1.2 SUMMARY

- A. Provide a Code Compliant Automatic Networked Lighting Control System for interior lighting as indicated on plans and outlined in this section.
 - 1. Control Devices under this section are shown diagrammatically on the drawings and additional Class 1 and/or Class 2 wiring may be required for a complete system. Class 2 wiring may be required in addition to the system network cable (i.e. 0-10V dimming circuits from control modules to lighting fixtures). It shall be the responsibility of the contractor and system vendor to determine the quantity and type of cable/wiring required for the complete and proper operation of the system. System design is based upon intelligent controls and/or lighting fixtures interconnected with network control cables (exception: Small spaces, such as private offices, where occupancy based control can be accomplished with one wall switch type occupancy sensor, to be provided by the same manufacturer). Control devices shall also be provided for automatic, occupancy based control of receptacle/plug loads where designated on the drawings. Control devices for controlled receptacles shall be compatible with, and connected to, the local lighting control network bus in each space. Controlled receptacles shall function to turn 'OFF' when the local occupancy/vacancy sensor (or sensors) in that space has detected vacancy for the specified time period. Receptacles that are connected to an automatic control device shall be clearly indicated with the industry standard icon for controlled plug loads.
 - 2. It is the electrical contractor's responsibility to include all material, labor and programming to provide a complete and properly working system that complies with listed sequences of operation and control zones indicated on the drawings.
 - 3. Proper product adjustment, testing, training and commissioning coordination shall take place in compliance with this document as well as applicable energy codes and listed sequences of operation.
- B. Exact configuration, wiring methods, and system topology may vary by manufacturer. The contractor proposing the substitution shall be responsible for all wiring and system components necessary to provide a complete system that functions as designed to meet the specified sequence of operation. The contractor shall be responsible for cost associated with any necessary re-design to the construction documents required for rough-in and installation. All substitutions are contingent on shop drawings, to be provided prior to system pre-installation meeting. Shop drawings shall include detailed information regarding manufacturer's recommendations for wiring methods, sensor placement, topology, and other system requirements.

1.3 SPECIAL SPECIFICATION AND OPERATION

- A. The lighting control system specified in this section shall provide a combination of time-based, sensor-based (both occupancy and daylight), and/or manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Dimmable lighting that is not in a daylight zone shall be manually dimmed from the associated control station(s) in the room. Dimmable lighting in daylight zones shall be automatically dimmed, with manual over ride control as described in this specification section and the sequence of operation for the applicable room requirements.
- C. All system devices shall be individually addressable and shall be networked together via network control cable to enable digital communication. Contractor to verify cable type and wiring topology required by manufacturer.
- D. Individual lighting zones shall be capable of being segmented into sufficient channels of occupancy, photocell, and switch functionality to comply with advanced configurations and sequences of operation. Daylight zones and switched zones may differ in some spaces. System shall be capable of automatically controlling dimmed daylight zones independently of switched zones.
- E. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function or global functionality as necessary to meet all sequences of operation.
- F. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
- G. Time of day capabilities must meet local code requirements or at a minimum a 10 hour backup, astronomic time function and Holiday function.
- H. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via the CAT5 network as required to alter time delays, disable/enable functions, remotely monitor activity, etc.
- I. The system architecture shall facilitate remote operation via a computer connection.
- J. Networked interior distributed lighting controls shall consist of lighting control modules, relays, and associated input devices that operate in default capacity even if network connectivity to the greater system is lost. (Note: control modules may be integrated into light fixture as an "intelligent" light fixture.)
- K. Occupancy based controls shall consist of Passive Infrared or dual-technology occupancy sensors connected via network control cable in larger, multi-zone spaces such as classrooms. In small offices, occupancy based controls shall include dual technology, single or multi-zone wall switch type occupancy sensors.
 - 1. Dual technology sensors shall consist of Passive Infrared as a primary technology and Microphonic or Ultrasonic as a secondary technology.
 - 2. Occupancy-based controls for interior lighting shall provide automatic shut-off control as indicated for manual-on or automatic-on lighting as designated by code or sequence of operation.
 - 3. Sensors covering 1 lighting zone with 1 lighting level shall be manual on, auto off. Where multiple lighting levels are indicated (bi-level control), sensors shall be auto on to 50%, manual on to 100%, auto off.
 - 4. Occupancy sensors shall provide complete and proper volumetric coverage of each room within the coverage limits of the devices provided, in accordance with the manufacturer's published coverage limits. Unless otherwise indicated, the coverage pattern shall provide detection of desk activity (hand motion) for over 90% of the room area

minimum, as required to accommodate all occupancy habits of single or multiple occupants at any location within each room.

5. Wall switch occupancy sensors, shall include means for manual adjustment. Sensors shall have adjustable sensitivity and time-delay settings, which shall be adjusted in each room to suit the actual room conditions. The occupancy sensors shall be adjusted such that the presence of one occupant within sight of the sensor is sufficient to keep the controls from automatically shutting off the lighting, with sufficient time-delay to allow an occupant to conduct any normal functions that may be out of sight from the sensor. Sensors covering 1 lighting zone with 1 lighting level shall be manual on, auto off. Where multiple lighting levels are indicated (bi-level control), sensors shall be auto on to 50%, manual on to 100%, auto off. Normal air movement while the room is unoccupied shall not in itself cause the occupancy sensors to remain activated. Sensor/Switches shall be provided with a button for each designated zone of control (or light level with rooms requiring bi-level switching).
6. Occupancy-based controls shall include auxiliary contacts for interface with the energy management or building automation system for HVAC system control, in accordance with the requirements of Section 230923. Refer to mechanical plans for required auxiliary contact requirements. Auxiliary contacts may be housed in a network control device, and not the occupancy sensor itself.
- L. Wall Control Stations (other than wall type, stand-alone occupancy sensor switches) shall be Class 2 devices networked with control cable and shall include on/off/dim or scene functions to initiate the proper sequence of operation for the space.
- M. A networked UL 924 compliant emergency control device shall be used that monitors a switched circuit providing normal lighting to an area, and an unswitched normal circuit. The unit provides normal ON/OFF/Dim control of emergency lighting along with the normal lighting (ON/OFF control is monitored by the switched monitor circuit). Upon normal power failure (loss of power to unswitched circuit), the emergency lighting circuit will close, forcing the emergency lighting ON and FULL if dimmed until normal power is restored. Upon restoration of normal power, lighting shall function as specified in default mode, which includes dimming and daylight harvesting.
- N. A control device shall be provided for receptacles/plug loads that are designated to have occupancy based automatic control on the drawings. The control device shall be rated for 20A, and be compatible with, and connected to the local lighting control network in each space via CAT-5E network cable. Control devices for receptacle/plug loads shall be programmed by default to be 'ON' whenever the local occupancy sensor detects occupancy in the room, and to turn 'OFF' after the sensor has detected vacancy for 15 continuous minutes. Control devices shall be installed in concealed, accessible locations, and be labeled with the circuit number for which they are installed.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of automatic lighting control device and equipment provided on the Project, up-dated to record changes.
- B. Shop Drawings: Layouts of photocells, occupancy sensors, and network devices necessary for a complete working system. Provide wiring diagrams showing the connection of all system parts, and showing all necessary electrical provisions to accommodate the intent of the design. Layouts of devices and wiring topology to be shown on project lighting plans, and supplemented with one-line wiring diagrams describing complete network configuration and topology.

- C. Installation and Start-up Instructions: Manufacturer's installation and start-up instructions. Submit to the Commissioning Authority with a copy to the Architect.
- D. Commissioning Notification: Written notification of the proposed date for performing commission activities. Submit to the Commissioning Authority with a copy to the Architect.
- E. Test Reports: Record of all field test data. Submit to the Commissioning Authority with a copy to the Architect.
- F. Training Documentation: Sign-off form and attendee sign-in sheet for the training session. Submit to the Commissioning Authority with a copy to the Architect.
- G. Meeting Minutes: For pre-installation meeting.
- H. Contractor shall initiate and schedule a pre-installation meeting with manufacturer's and owner's representative.

1.5 OPERATING AND MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Operating Instructions: Supply a detailed narrative description of the operation of the lighting controls. Indicate application conditions, limitations of use, coverage patterns and adjustments. Include manufacturer's installation instructions.
- C. Maintenance Instructions: List replacement parts, including source. Indicate recommended maintenance and testing procedures and intervals. List all individual system components that require periodic maintenance. Include a service directory with names and telephone numbers to obtain service.
- D. Warrantee: Manufacturer's warranty certificate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials for complete system shall be provided per manufacturer to meet the performance criteria in this specification, and the sequence of operation for each space. Refer to the lighting control devices schedule for additional information on specific products and intended sequence of operation.
- B. Wall Switch Occupancy Sensors: Decora style wiring device shall include "off" and "auto" controls, a dual technology, passive infrared/ultrasonic occupancy sensor and an indicator light that illuminates when the sensor detects occupancy. The sensor shall have a high-density 180° coverage pattern that detects walking motion within 7.5 m (24 ft.) in front of the device and 3.0m (10 ft.) to either side when mounted 1.2 m (4 ft.) above the floor. The device shall be arranged for manual control to switch lights on, and automatic control to switch lights off. Sensors shall have adjustable sensitivity (minimum to maximum) and time delay (30 seconds to 30 minutes) settings. Sensors shall initially be set at maximum sensitivity and 15 minutes delay. The device shall be rated for control of up to 800 Watts of load at 120 VAC. The device shall allow no leakage to load when in the "off" mode, and shall have no minimum load requirement. Wall switch occupancy sensors shall be equivalent to the following based on type of control specified: Type DW: Manual ON, Automatic OFF Wall switch type dual technology, passive Infrared and ultrasonic occupancy sensor with built-in override control (off-auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; To be furnished by manufacturer of complete distributed lighting control system.

2.2 WIRE AND CABLE

- A. General: Wire size shall be minimum #12 AWG, except low-voltage control cable. Power and grounding conductors shall be minimum #12 AWG. Cable shall be rated CL2 where installed in conduit. Cable run open air shall be CL2P, plenum rated.

- B. Network cable: to be provided per manufacturer's requirements. Network cable shall be white.
- C. Low-Voltage Control Cable: #16 AWG, multi-conductor cable with jacket to match color of network cable, except as otherwise indicated. Quantity of conductors as required for connected devices. Dimming control cabling (0-10V) shall be installed in raceway (1/2" EMT), except where installed above an accessible ceiling. All cable in plenum spaces shall be plenum rated.

2.3 MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above, and as follows.
 - 1. All network control devices: Acuity nLight, or prior approved equivalent. See Part B of this paragraph.
 - 2. Cable: Belden, Canare, West Penn, or as specified by the manufacturer.
- B. Substitutions may be considered only when submitted in conformance with Section 260500, and explicitly approved by the Engineer and Owner.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning rough-in for the automatic lighting controls, The Electrical Contractor shall arrange a pre-installation meeting on the site between all parties involved in the automatic lighting control system installation, including the Electrical Systems Installer, the manufacturer's Factory Authorized Representative and the Owner's Representative. All parties shall review the automatic lighting control shop drawings, the manufacturer's installation instructions, applicable regulations and any site conditions pertinent to installation of the automatic lighting controls. Verify placement of sensors and installation criteria.
- B. The Electrical Contractor shall prepare minutes of the pre-installation meeting and distribute them to all parties in attendance at the meeting, as well as the Owner's Representative and the Architect.

3.2 INSTALLATION

- A. Install equipment in accordance with the manufacturer's instructions in the locations indicated on the Drawings. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. All Category cable shall be installed in accordance with T568B specifications.
- B. Coordinate the control requirements of all devices and sensors to insure proper operation. Provide all necessary accessories.
- C. Locate interior photocells where they are protected from direct sunlight and where they can be aimed toward the zone they are controlling. Photocells to be installed per manufacturer's recommendations, and should be closed-loop, requiring multiple sensors for rooms with multiple daylight zones and zoning per day-lighting requirements. Photocells controlling non-dimmed zones shall consider natural and artificial light, but not be in direct sunlight, or directly under a lamp source.
- D. Locate and aim occupancy sensors as required for complete and proper volumetric coverage within the range of coverage of controlled areas per the manufacturer's recommendations. Rooms shall have 90% minimum coverage to completely cover the controlled area. Coverage shall accommodate all occupancy habits of single or multiple occupants at any location within the room. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the minimum quantity and placement of sensors that are to be provided. Provide additional sensors if required to properly and

completely cover the respective room. Locations shall be carefully selected to insure that coverage patterns are unobstructed.

- E. Contractor is to provide a sufficient quantity and layout of occupancy sensors to properly meet coverage and intended sequence of operation. Locations shall be carefully selected to insure that coverage patterns are unobstructed.
- F. Mount occupancy sensors and photocells in finished spaces according to manufacturer instructions. In unfinished spaces or where ceiling-type sensors are installed where there is exposed structure, mount the sensors in surface mounted outlet boxes.
- G. Wiring shall be arranged as shown on the shop drawings. Wiring and cable shall be installed in raceways or cable trays, except low-voltage cables run above accessible ceilings consisting of removable tiles. Raceways shall be grounded to the power system ground.
 - 1. Network control cables shall connect control devices in uninterrupted continuous runs without intermediate splices. Cables shall be free from shorts or ground and shall be tested.
 - 2. Cables shall be routed so as to maintain a separation of at least 610 mm (24 in) from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Avoid exposed cables in occupied areas or in areas where they might be damaged as a result of normal use of the area. Where two (2) or more cables run in parallel, they shall be bundled with cable ties.
 - 3. Cables run exposed in ceiling cavities shall be supported by means of suitable cable support devices from the building structure. They shall not lie upon the ceiling, nor shall they be supported from the ceiling frame, ceiling suspension wires, conduits, pipes, ductwork or lights. Supports shall be spaced no further apart than 5 ft. on center.
 - 4. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced. Type and spacing of supports shall ensure that cable will not kink or sag.
 - 5. In each cable that terminates at a ceiling device, provide 305 mm (12 in) of slack cable, neatly coiled, to facilitate future modifications. Terminations shall be made in a neat and workmanlike manner, and in accordance with Section 271500.
 - 6. Terminate the manufacturer's recommended cable type to the appropriate termination point (RJ45 jack, etc.).
 - 7. Cabling for 0-10V dimming control shall be installed in raceway (1/2" EMT), except where installed above accessible ceiling. Cabling for 0-10v dimming control shall be Class 2 and separate from any line voltage wiring. Raceway shall be installed orthogonal to room surfaces, and be concealed by structure wherever possible.
 - 8. Networked control cable shall be run orthogonal to room surfaces, be routed along edges of rooms and concealed by structure wherever possible. Network cable shall be installed in raceway (1/2" EMT) in exposed or open ceilings and may end when cable reaches cable tray or accessible ceiling space. Electrical Contractor to record and provide identification of control devices (Device ID #'s) in each space per manufacturer instructions. All power packs and control devices shall be labeled with the corresponding circuit number, and locations shall be documented on as built drawings.

3.3 ADJUSTMENT, TESTING, DEMONSTRATION & COMMISSIONING

- A. Notify the Owner's Representative and the Commissioning Authority at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests.
- B. The automatic lighting control devices are subject to commissioning. The Electrical Contractor shall assist the Commissioning Authority with scheduling

and coordinating commissioning activities, developing commissioning test procedures, conducting commissioning tests, preparing commissioning documentation, and developing a training plan in accordance with specific responsibilities as assigned in Section 019100. Prior to the start of functional performance testing for commissioning purposes, complete all start-up and checkout procedures and verify that the equipment is completely ready to be tested. A knowledgeable electrician in the employ of the Electrical Installer shall be present during functional performance testing for commissioning purposes.

- C. The Contractor is to supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment, testing and demonstration as needed.
- D. Prior to system testing, the Electrical Contractor shall prepare a list of the devices to be tested, together with the associated location of each device and device identification (bar code number, ID, etc.). Include space to indicate test response for each device.
- E. During adjustment and testing, the Electrical Contractor shall carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating & Maintenance Manuals. A device settings report from applicable software is also acceptable documentation.
- F. Initial Set-up: Verify that wiring is correctly connected to each device. Adjust controls to function as specified under the sequence of operation. Settings shall comply with direction received from the Architect's Consultant and/or sequence of operation. Default to IES light levels if information is not available at time of initial set up.
- G. Program sequences of operation that include time functions to operate at times selected by the Owner's Representative. Information must be available before technician is scheduled for start-up.
- H. Field Testing: Test all system features for proper function. Tests to be performed shall include, but not be limited to, the following:
 - 1. Verify the sequence of operation for each device.
 - 2. Verify the setting and accuracy of each timing function in each device.
 - 3. Verify that each manual override control functions properly.
 - 4. Verify that occupancy sensors do not remain actuated due to normal conditions (e.g., air movement).
 - 5. Verify that occupancy sensors are actuated by hand motion within the entire area of coverage.
 - 6. Verify that occupancy sensors actuate when a person enters the area of coverage.
 - 7. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections as part of the required installation and testing.

3.4 ON-SITE TRAINING

- A. After the system has been completed, tested and is operating properly, the manufacturer's representative shall demonstrate by actual usage, the proper operation of each system device and function in the presence of the Owner's Representative. Demonstration shall include repetition of selected field tests, as well as additional adjustment or testing required to demonstrate that the system performs in accordance with the operational description as specified herein and the Owner's operational requirements.
- B. On-site training shall be coordinated with the Commissioning Authority in accordance with Sections 019100. At least two (2) months prior to the anticipated training session, submit a draft of the training plan and the proposed participants to the Commissioning Authority for review and comment. Two (2) weeks prior to the scheduled training, submit to the Commissioning Authority a

revised written training plan incorporating the Commissioning Authority's comments.

- C. The Electrical Contractor shall coordinate end user training to be conducted after the Operating and Maintenance Manuals for the project are completed and available for use during the training session.
- D. An authorized factory representative shall conduct two (2) hours minimum of training for the Owner's maintenance personnel in the operation and maintenance of the lighting controls and applicable software. Training time shall be extended as necessary to satisfy the Owner's Representative that all pertinent topics have been adequately covered.
- E. The Electrical Contractor shall maintain a training sign-in sheet, upon which participants in the training session, including the instructors, shall record their names. The training sign-in sheet shall be dated.
- F. On-site training shall follow a written training plan, prepared in advance. The training plan shall outline the topics to be covered, the publications to be used, and the training schedule.
- G. The training shall be conducted by technicians who are thoroughly familiar with the equipment and its features, and also with the Project. The training shall include instruction, field demonstration, and over-the-shoulder hands-on exercises. As a minimum, the training shall cover, but not be limited to, the following topics:
 - 1. General overview of lighting controls, including purpose and principle of operation.
 - 2. Location of lighting control components.
 - 3. Interpretation of equipment output devices, such as indicators and status contacts.
 - 4. Control adjustments and settings.
 - 5. Operation of system controls, including over-ride switches.
 - 6. Recommended maintenance procedures and intervals.
- H. At the conclusion of the training session, the Electrical Contractor shall obtain written sign-off from the Commissioning Authority and the Owner's Representative. Insert a copy of the sign-off form and the training sign-in sheet into the Operating and Maintenance Manuals. Submit another copy of the training sign-in sheet to the Architect.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Detail enclosure types including mounting and anchorage, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

- A. Typed panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- 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. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.

- 2. Height: 84 inches maximum.
- 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- E. Incoming Mains Location: Convertible between top and bottom.
- F. Phase, Neutral, and Ground Buses: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression or Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type, with a lug on the bar for each pole in the panelboard.
- H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices as noted on the drawings.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; by Schneider Electric.
 - 2. Substitutions: Under provisions of Division 01.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Hinged, secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As indicated on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; by Schneider Electric.
 - 2. Substitutions: Under provisions of Division 01.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; by Schneider Electric.
 - 2. Substitutions: Under provisions of Division 01.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 225 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. GFPA Circuit Breakers: Single and double-pole configurations with ground fault protection (30mA-trip).
 - 7. MCCB Available Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover. Circuit directory shall be typed and dated with month and year that circuit directory was provided.

- D. Where more than one nominal voltage is present on the premises, the conductor color-coding legend shall be permanently posted at each branch circuit and distribution panelboard.
- E. All panelboards shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount top of trim 78 inches above finished floor, or the height of the panelboard, unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Straight-blade convenience receptacles.
 - 2. GFCI receptacles.
 - 3. Controlled receptacles.
 - 4. Toggle switches.
 - 5. Wall switch sensor light switches with dual technology sensors.
 - 6. Wall plates.

1.2 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
 - 1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
 - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
 - 3. Leviton: Leviton Mfg. Company, Inc.
 - 4. Pass & Seymour: Pass& Seymour/Legrand.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- D. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.3 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight blade, non-feed-through type.

2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- 2.4 CONTROLLED RECEPTACLES
- A. Provide controlled receptacles with the word “controlled” and power symbol on device face per NEC 406.3(E).
- 2.5 TOGGLE SWITCHES
- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - B. Switches, 120/277 V, 20 A.
- 2.6 WALL SWITCH SENSOR LIGHT SWITCH, DUAL TECHNOLOGY
- A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.
 1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for LED lighting, and 1/4 hp at 120-V ac.
 2. Integral relay for connection to BAS.
 3. Adjustable time delay of 15 minutes.
 4. Able to be locked to Automatic-On or Manual-On mode.
 5. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
 6. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- 2.7 WALL PLATES
- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Stainless Steel, smooth, type 302.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
 - B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
- 2.8 FINISHES
- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
 - B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation and painting is complete.
 - C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- H. GFCI Receptacles: Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.2 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Perform the following tests and inspections:
1. Tests for Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - c. Ground Impedance: Values of up to 2 ohms are acceptable.
 - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - e. Using the test plug, verify that the device and its outlet box are securely mounted.
 - f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct

circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed switches.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-5, FRN-R: 250-V.
 - 2. Type RK-5, FRS-R: 600-V.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
 2. General Electric Company.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
1. Single throw.
 2. Three pole.
 3. 240 or 600-VAC.
 4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company.
 3. SIEMENS Industry, Inc.; Energy Management Division.
 4. Square D; by Schneider Electric.
- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish:
1. Dry Interior Locations: NEMA 250, Type 1, finished with gray enamel paint.
 2. Wet or Exterior Locations: NEMA 250, Type 3R, finished with gray enamel paint.
 3. Kitchen Locations: NEMA 250, Type 4X, stainless steel.
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.
- D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1)] or directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to

- override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250, Type 4X stainless steel shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Indoor/Outdoor locations subject to water spray: NEMA 250, Type 4X.
 4. Kitchens: NEMA 250, Type 4X Stainless Steel.

3.2 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.
- F. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections
- B. Tests and Inspections for Switches:
1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify correct phase barrier installation.
 - i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
- 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- E. Inspect and test in accordance with NETA ATS,

END OF SECTION 26 28 16

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, I-nominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; by Schneider Electric.
 - 2. Substitutions: Under provisions of Division 01.
- B. SPDs: Comply with UL 1449, Type 2.
 - 1. SPDs with the following features and accessories:
 - a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - b. Indicator light display for protection status.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V.

- 2. Line to Ground: 1200 V for 480Y/277 V.
- 3. Line to Line: 2000 V for 480Y/277 V.
- E. SCCR: Equal or exceed **100 kA**.
- F. Nominal Rating: 20 kA.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 26 43 13

SECTION 26 51 10 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 1 specifications, apply to work specified in this section.
- B. Related Sections:
 - 1. Section 260500 – General Provisions for Electrical Systems.
 - 2. Section 260526 – Grounding & Bonding: Requirements for bonding.
 - 3. Section 260529 – Hangers and Supports: Luminaire support requirements.

1.2 SUMMARY

- A. Provide luminaires, including emergency lighting and exit signs, at all interior locations indicated on the Drawings.
- B. Adjust and aim luminaires and verify proper operation.

1.3 DESCRIPTION

- A. Luminaires shall be complete with trim, mounting hardware, drivers and LED modules, and shall be suitable for the location in which they are installed.
- B. Provide all materials required to entirely complete each luminaire ready for use, in accordance with the conditions and requirements of the building construction.

1.4 WARRANTY

- A. In addition to the warranty specified in the General Conditions, each manufacturer of electronic lighting components shall warranty the electronic ballasts and LED drivers to be free from defects in materials and workmanship. This additional warranty shall extend for a period of at least five (5) years from the date of manufacture or purchase. For items covered by such warranty, the effective date shall in no case be more than two (2) years prior to the final date of Substantial Completion for the Project. The warranty shall cover the full cost of repairing all the components or furnishing replacements in kind. The warranty shall not be pro-rated and there shall be no deductible amount. Include warranty certificate in the Operating and Maintenance Manuals.

1.5 SUBMITTALS

- A. Product Data: Specific product data shall be provided for each type of luminaire, light pole, driver, LED module provided for interior and exterior lighting on the Project. Include physical description, materials and finishes, dimensions, weights, accessories, photometry data and efficiency data, as applicable. Product data shall also include documentation indicating that all LED systems are provided and tested in accordance with IES LM-79 and LM-80. Submittal data must include documentation that the light engine and driver electronics have been tested as a system and UL listed for the application for which they are being installed.
- B. Shop Drawings: Outline drawings and fabrication details for each custom-fabricated luminaire type provided on the Project, indicating dimensions, weights, methods of field assembly, components, features, and accessories. Wiring diagrams for “master/slave” tandem wired luminaires.

- C. Test Reports: Record of all field test data.
- D. Training Documentation: Sign-off form and attendee sign-in sheet for the training session. Documentation shall also be provided to record meeting minutes of lighting and controls pre-installation meeting(s).

1.6 INFORMATION FOR OPERATING & MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Maintenance Instructions: List replacement parts, including source. Indicate recommended and required maintenance and testing procedures and intervals. List all individual lighting components that require periodic maintenance. Identify features, accessory attachments, safety precautions, and procedures for cleaning, lamp replacement and adjustment. Include manufacturer's installation instructions. Detail trouble-shooting procedures, including step-by-step instructions for typical trouble symptoms. Detail waste disposal procedures, including recycling options, for compliance with government regulations covering the disposal of lamps containing mercury.
- C. Warranty: Electronic ballast, driver, and rechargeable battery component manufacturers' warranty certificates.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. See schedule on Drawings for listing of required luminaires. Luminaires shall be complete with trim and mounting hardware. Provide hardware for each luminaire based on the ceiling condition for which it is to be installed.
- B. All luminaires shall bear the UL label associated with the type, location, ambient temperature and usage of the individual luminaire. All luminaires shall be included with drivers that have been UL listed or recognized for use in that specific fixture. Documentation indicating UL listing(s) shall be provided with product submittals.
- C. Integral LED drivers shall be installed by the manufacturer, and supplied as a total system with the fixture housing and LED modules/boards.
- D. Custom colors shall be applied to luminaires as indicated on the luminaire schedule. Custom colors shall match color samples supplied by the Architect.
- E. Luminaires equipped with doors shall be free of light leakage around the doors under normal operating conditions. Doors shall be designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in the normal operating position. Doors shall utilize spring-loaded latches on fluorescent troffers and on other luminaires that are available with such an option.
- F. All plastic lenses shall be UV-stabilized virgin acrylic unless otherwise indicated. Flat plastic lenses shall be KSH-12 or equal and a minimum of 0.125 in thick. Prisms shall be square cut at 45°; round cut is not acceptable.
- G. All louvered luminaires shall be shipped with dust covers. Covers shall be removed after final building vacuuming has been completed.
- H. Exit signs shall be internally-illuminated. Illumination of lettering on each sign shall be diffuse, with a minimum luminance of 8.6 candela/m² (2.5 foot-lambert).
- I. LED luminaires are to be coordinated with the lighting control system, and supplied with all necessary components to produce a fully functional system. Components may vary based on the lighting control approach of the relevant manufacturers. (i.e. The lighting control manufacturer can supply all control

equipment and devices to be external of the lighting fixtures. However, some systems that are approved for bid accommodate fixtures with integral components that can be connected to the digital distributed lighting control system). See section 260923 – Distributed Lighting Control.

2.2 DRIVERS

- A. Each luminaire shall be provided with a driver of one of the types specified herein, suitable for operation of the indicated lamp type. Driver voltage rating shall be selected to match circuit voltage.
- B. The wiring to each LED driver shall be equipped with push-in ballast disconnect plugs. Line-side terminals of disconnect plugs shall be guarded. Disconnect plugs shall be located within the driver compartment.
- C. LED Drivers: LED drivers to be between 300mA and 1000mA as indicated by specification information in the luminaire schedule or as required by the manufacturer of each specified product. Each driver to be tested with LED module for which it is installed per IESNA LM-79 and LM-80 certification standards, and the entire fixture/driver/light engine assembly shall be UL listed (all documentation regarding fixture assembly UL listing is required to be included with the fixture submittal package). LED drivers to be supplied by luminaire manufacturer, and supplied with the fixture as a tested and certified system.
 - 1. LED drivers shall be available for voltages listed on drawings.
 - 2. LED drivers shall be provided with 0-10V dimming capabilities in all areas with dimming/daylighting harvesting controls.
 - 3. LED luminaires indicated as emergency lights on drawings shall be compatible with emergency battery packs that support LED, to be provided by the fixture manufacturer.

2.3 LAMPS

- A. All luminaires shall be complete with LED.
- B. Light-Emitting Diode (LED):
 - 1. White LED Lamps: Projected rated life shall be 60,000 hours, at 85% lumen output (minimum).
 - 2. Colored LED Lamps: Rated 50,000 hour life minimum.
 - 3. Led to be driven at nominal drive current for the specified output (300mA-1000mA range) and tested with LED driver as a complete system for which it is installed per IESNA LM-79 and LM-80 certification standards.
 - 4. LEDs used in general lighting applications to utilize phosphor technology.
 - 5. LED color temperature and binning to be within a 3-step MacAdam ellipse.

2.4 ACCEPTABLE MANUFACTURERS

- A. Manufacturers of luminaires shall be as indicated on the luminaire schedule.
- B. Manufacturers of drivers shall be as follows:
 - 1. Driver disconnect plugs – Ideal “Power-Plug” Series.
 - 2. LED Drivers – Phillips Advance, OSRAM, EldoLED, or as provided/recommended by luminaire manufacturer. All driver information for alternate manufacturers to be provided in lighting submittal package.

- C. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install luminaires in accordance with the manufacturer's recommendations and installation details.
- B. Provide backboxes matched to luminaires. Where luminaires are suspended from ceiling grids, provide special interface outlet boxes designed to mount on grid members and facilitate power cable interface at the suspension point canopy, such that the power cable neither lies exposed above the ceiling nor runs in raceway. In other locations, where luminaire manufacturer's installation instructions indicate use of standard outlet boxes, boxes shall be in accordance with Section 260533. Back boxes shall be plumb and perfectly aligned.
- C. Installation of custom luminaires shall be coordinated between architect, engineer, contractor, and manufacturer before installation or rough-in or luminaire assemblies or series of luminaire assemblies. Where isometric drawings of fixture assemblies were included in documents, shop drawings shall be provided by the manufacturer and reviewed by architect and engineer prior to installation. Contractor to schedule pre installation meeting with all parties before installation of custom detailed fixtures are installed.
- D. Mount interior luminaires at locations indicated on the drawings. Support luminaires in accordance with Section 260529, in the following manner:
 - 1. Mount suspended stem supported luminaires on swivel hangers where required which are a standard catalog item of the same manufacture as the luminaire. Support from fixture stud, or as otherwise recommended by the manufacturer. For linear luminaires, provide one more hanger than the number of luminaires in the row. Coordinate degree of swivel with the ceiling slope. Other suspension methods may be considered in mechanical type rooms where approved by Architect's Consultant.
 - 2. Mount suspended aircraft cable supported luminaires on canopies which are a standard catalog item of the same manufacture as the luminaire. Support from ceiling grid where applicable, or as otherwise recommended by the manufacturer. For linear luminaires, provide one more hanger than the number of luminaires in the row.
 - 3. Mount suspended chain supported luminaires on hangers which are a catalog item of the same manufacture as the luminaire. Support from building structure as recommended by the manufacturer. For linear luminaires, provide one more hanger than the number of luminaires in the row.
 - 4. Mount surface and wall luminaires square with the room. Support from fixture stud or as otherwise recommended by the manufacturer. Attach surface luminaires at two (2) support points, minimum. Provide 38mm (1½ in) metal spacers for luminaires which occur on combustible ceilings. Submit spacer for approval.
 - 5. Install recessed luminaires in suspended acoustical ceiling systems in accordance with the provisions of ASTM C636. Verify all ceiling types and ceiling thicknesses to ensure that recessed luminaires can be properly installed. Provide plaster frame mounting kits where recessed luminaires are to be installed in hard ceilings.

- E. Verify all measurements. Luminaires must fit in place in a regular, trim and workmanlike manner, to the satisfaction of the Architect's Consultant. Verify the type of ceiling system in every room or space to ensure that the luminaires are compatible before releasing orders for luminaires. Incorrectly ordered luminaires shall be replaced, with no additional compensation.
- F. Verify luminaire locations with the Architectural reflected ceiling plans and interior wall elevations, when such plans and elevations are included in the Contract Documents.
- G. All recessed luminaires installed in accessible ceilings shall be connected by means of a flexible raceway or fixture whip which is attached to a 100 mm (4 in) square junction box. Box may serve more than one luminaire.
- H. Provide bonding connections in accordance with Section 260526 and manufacturer's installation instructions.
- I. After installation, all visible labels shall be removed from luminaires.
- J. Immediately prior to occupancy, clean reflectors, aperture plates, lenses, louvers, luminaire housings and decorative elements. To prevent static buildup on lenses and reflectors, clean with a manufacturer's recommended water-diluted solution of glass cleaner and allow to air-dry after installation.
- K. Broken or defective parts shall be replaced, with no additional compensation.

3.2 ADJUSTMENT & TESTING

- A. Notify the Owner's Representative at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests.
- B. Supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment and testing, and demonstration.
- C. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating & Maintenance Manuals.
- D. Upon completion of the installation, aim all adjustable luminaires as directed by the Architect's Consultant. After adjustments are complete, measure the illumination levels at selected points to demonstrate proper distribution and coverage. Verify with the Architect's Consultant the points where illumination levels are to be measured.
- E. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections, with no additional compensation.

END OF SECTION 26 51 10

SECTION 26 52 19 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Emergency lighting units.
 - 2. Exit signs.
 - 3. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:
- B. Product Certificates: For each type of luminaire.
- C. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for recessed luminaires.

2.2 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 - 1. Emergency Luminaires: As indicated on Drawings, connected to emergency inverter.

2.3 EXIT SIGNS

- A. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 - 1. Smooth operating, free of light leakage under operating conditions.
 - 2. Designed to permit relamping without use of tools.
 - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.5 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach fixtures directly to gypsum board.
- F. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and

- provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
- 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
- H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 26 52 19

SECTION 26 56 00 – SPORTS FIELD LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the bid documents, including general and supplementary conditions apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Luminaire, with appropriate glare/spill light control:
 - 2. LED Lighting
 - 3. Control System.
- B. The purpose of this specification is to define the performance standards, product values and features required manufacturer's service responsibilities, and design standards for Fran Rish Stadium.
- C. Alternate Bid #3 – Provide field lighting controls and field lighting on the home and visitor's side of field shall be replaced with LED lighting as part of alternate bid #3 only. Provide all materials and labor as required.
- D. Alternate Bid #4a – Provide RGB pole lighting accent for each of the (4) field lighting poles.
- E. Alternate Bid #4b – Provide show lighting control systems package.
- F. Alternate Bid #4c – Provide RGB light fixture to illuminate grandstands in lieu of standard light fixture.

1.3 ACTION SUBMITTALS

- A. It has been predetermined that these project specifications are the minimum acceptable criteria for this project. Musco Sports Lighting LLC is the only pre-approved equipment supplier.
- B. Manufacturers requesting approval shall provide submittal information as per Section 1.03 D. Submittal information must be received 10 days prior to bid opening, approved manufacturers will be notified by addendum.
- C. Submit each item in this article according to the conditions of the contract and specification section. Any deviations to the specification require the manufacturer to list and describe in detail such deviations. Failure to provide this information shall be grounds for immediate rejection.
- D. Submittal information required:
 - 1. Light layouts as per Section 1.04 and 1.05 of the specification.
 - 2. Spill and Glare layouts as per Section 1.06 of the specification.
 - 3. Photometric report for a luminaire types being proposed showing candela tabulations as defined by IESNA. Photometric data shall be certified by a laboratory with current NVLAP or an independent testing facility with over 5 years experience.
 - 4. Provide written information for the automated control system to include monitoring. Also provide examples of system reporting and access for numbers for personal contact to operate the system.
 - 5. Detailed warranty information as per Section 3.01 of the specification.
 - 6. A list of 10 similar project references in Washington using the proposed LED equipment. The list shall include contact names and phone numbers.

1.4 SPORTS LIGHTING PERFORMANCE

- A. The manufacturer shall supply lighting equipment and computer-generated point-by-point analysis to meet the following:

1. The performance criteria requires lighting equipment which will provide measured average illumination level of the predicted mean in accordance with IESNA - LM 5 and measured within the first 100 hours of operation. Light Levels shall meet or exceed the following for the entire duration of the warranty.

Area of Lighting	Entire Area
Football/Soccer Field	50.0 footcandles
Track	10.0 footcandles

1.5 POINT BY POINT ANALYSIS

- A. Submitted computer models shall depict the Measurements of light shall be demonstrated on a computer generated model which consists of a grid of a specified number of points covering a stated area on an equally spaced grid. See the below chart for the exact specifications of points, areas, and grid spacing for the field.

1. Computer Models – Test Stations

Area of Lighting	# of Points	Size of Area to be Covered	Grid Spacing
Football/Soccer Field	84	Entire Field	30' x 30'
Track	44	Entire Length	30'

1.6 SPILL/GLARE ANALYSIS

- A. Submitted spill/glare computer models shall depict the field test stations every 30' located 100' from the edge of playing surface @ 3' above grade. Bidder shall submit as described below:

1. Spill Light Values: No single point along the line shall exceed the levels shown below. "Horizontal Footcandles" is measured with the light meter facing directly skyward, 90 degrees from true vertical. The test stations shall be shown every 30' along the line with the field lights on. These levels shall be shown as initial footcandles.

Along the Line	Horizontal Footcandles
30' Spacing	0.05

2. Spill Light Values: No single point along the line shall exceed the levels shown below. "Maximum Footcandles" is measured with the light meter facing directly toward the brightest bank of lights. The test stations shall be shown every 30' along the line with the field lights on. These levels shall be shown as initial footcandles.

Along the Line	Maximum Footcandles
30' Spacing	.10

3. Candela Values: Candela values shall represent individual fixtures. No single fixture shall exceed the values shown below at any location along the line. These values shall be shown as initial readings.

Along the Line	Maximum Candela
30' Spacing	3,000

1.7 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIGHTING STRUCTURE

A. General Description

1. The lighting structure system shall consist of a steel pole and steel crossarm assembly, wire harness, and electrical component enclosure (ECE). The pole shall be supported by a pre-stressed concrete base section embedded in concrete backfill or a concrete foundation supported by an anchor bolt and base plate assembly with a concrete foundation.

B. Poletop Structural Steel

1. The wind loading on the pole and all attachments shall be based upon 2018 IBC 110 mph, exposure C.
2. The poletop assembly shall be designed of sufficient strength to supports the effective projected area (EPA) of the attached devices including, as applicable, light fixtures, crossarms and mounting brackets.
3. The poletop assembly shall be high strength low alloy tapered tubular steel that is equal to current ASTM A595 standards, with galvanized coating inside and out. The connection of the poletop shall be by slip fitting the top section over the lower section by a length of at least 1.5 times the diameter.
4. Steel components of the poletop shall be hot dip galvanized t current ASTM A-123. To avoid problems of galvanize adherence to differing steel alloys, all steel components used for the poletop must be of the same type steel. There shall be a cap at the top of the pole so that rain will not enter the interior of the pole.

C. Luminaire Assembly

1. The LED luminaires shall be separate from the drivers and fusing. Drivers to be mounted remote from the Luminaire in the Electrical Components Enclosure (ECE). The ECE shall be located on the pole approximately 10' above grade and shall be accessible from a step ladder. The ECE shall be aluminum to ensure maximum heat dissipation. The luminaire shall be powder coated gray to match the ECE.
2. Each luminaire shall arrive completely assembled and be ready to attach to the crossarm in such a way that its aiming position has been determined relative to all other fixtures on the pole, so that in the factory

- all luminaires on the assembly are oriented to form a single photometric unit.
3. The luminaires shall be designed in such a way that the light source shall not be visible from any location beyond 150' of the field boundary lines of the track.
 4. The luminaires shall be fully shielded to reduce offsite spill light and glare. The visors shall be powder coated gray to match the Luminaires.
 5. The crossarm mounting plate shall be attached to the crossarm assembly at the factory and be constructed in such a way that the pre-assembled luminaire shall attach using 2 stainless steel threaded bolts.
 6. The LED Luminaires shall be no more than 1500 watt.
 7. Minimum of 5,700 Color Temp and 75+ CRI.
 8. Fixture Operating Temperature Range of -30 Degrees C to 55 Degrees C. Maximum Junction Temperature for the diodes of 80 degrees C.
 9. Electronic Driver with an efficiency of 95% or greater. Maximum starting inrush of 7 amps at 25 degrees C.
 10. Secondary Wiring: Manufacturer shall supply all necessary wiring to connect the fixture to the driver enclosure. Wiring shall be protected with either a jacketed cord or conduit and shall be internal to the pole.
- D. Electrical Components Enclosure (ECE)
1. The ECE shall be a NEMA 3R rated gasketed enclosure to house the drivers, fuses, circuit disconnect, and distribution lugs. The ECE shall be divided into two compartments. The upper compartment shall house the drivers, and fuses. The lower compartment shall provide for the circuit disconnect, distribution lugs, and connection of all circuits coming into and out of the ECE.
 2. The access door to the ECE shall be attached by a full-length stainless steel or powder coated aluminum hinge and shall be secured when closed by lockable stainless-steel latches. All latches, hinges, and non-current carrying fasteners, either outside or inside the enclosure, shall be stainless steel of at least an 18-8 standard.
 3. There shall be provided within the ECE a UL listed circuit disconnect, utilized as a local electrical disconnecting device such that electrical power to all equipment on the pole served by the feeder circuit shall be disengaged by the operation of one switch. The breaker shall be located in a compartment separated from the drivers.
 4. There shall be provided by the manufacturer a set of distribution terminal blocks, which shall be factory wired from the breaker to the blocks. These blocks shall provide for termination of all driver connection wiring.
 5. The ECE shall be attached to the pole with the lower end approximately 10' above grade at the pole foundation and shall be accessible from a step ladder.
 6. The ECE shall be listed by UL both for use with 90 degrees C rated conductors and as suitable for use in wet locations.

2.2 CONTROL AND MONITORING SYSTEM

- A. Factory assembled lighting control cabinet (LCC) – The LCC shall be assembled and wired by a UL listed panel builder. The LCC shall contain Contactors, Monitoring and Control System and door mounted Manual off-on-auto selector switches. The LCC shall arrive at the job site ready to attach to an existing wall, switchgear, or a freestanding enclosure.
1. Control Wire Terminations - The Control Wire Terminations shall include UL listed terminal blocks mounted on a DIN rail and 250-volt, 16 amp, touch safe type fuse holders.

2. The ECE shall be constructed of aluminum and shall be powder coated gray. The cabinet door shall utilize a lockable, 3-point latching assembly that provides a NEMA 4 rated seal.
 3. Contactor Modules – Contactors shall be UL listed for lighting applications. They shall be rated at full capacity, be electrically held, utilize a 120-volt coil and be rated for operation in an ambient temperature range from -40 degrees C to +70 degrees C.
 4. Manual off-on-auto Selector Switches – For on site manual control, three position selector switches shall be factory mounted to the ECE door. The switches shall be keyed and maintain position, with make before break contacts. The switches shall be factory wired to control terminal blocks.
 5. Warranty – The LCC shall be covered under the standard warranty for the accompanying lighting equipment (3.01).
- B. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The manufacturer shall notify the owner of outages within 24 hours, or the next business day. The controller shall determine switch position (manual or auto) and contactor status (open or closed). The Monitoring System shall be factory wired to control terminal blocks.
- C. Remote Lighting Control System: The Lighting Control System shall allow owners and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs. The Light Control System shall be factory wired to control terminal blocks.

PART 3 - EXECUTION

3.1 WARRANTY

- A. A. The manufacturer shall warrant the system does not fall below the designed lighting levels throughout the entire warranty period (25 years). The manufacturer shall provide all labor and materials and equipment to all Maintenance.
- B. Preventative and spot maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment delivery. Individual luminaire outages shall be repaired when the outages occur, there shall be no minimum outages required before action is taken. Owner agrees to check fuses in the event of an outage.

3.2 INSPECTION AND VERIFICATION

- A. The lighting manufacturer shall guarantee illumination light levels do not drop below the criteria detailed in section 1.04. Field measurements shall be done per IESNA RP-6-15 recommendations. Failure to achieve the required results will require individual fixture re-aiming and re-measurements at the expense of the manufacturer.

3.3 FIELD TECHNICIAN

- A. Manufacturer shall have available a local factory trained technician to provide project support including but not limited to: Luminaire replacement, confirm luminaire aiming points, troubleshoot, and educate customer maintenance personnel.

END OF SECTION 26 56 00

SECTION 26 56 10 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 1 specifications, apply to work specified in this section.
- B. Related Sections:
 - 1. Section 260500 – General Provisions for Electrical Systems
 - 2. Section 260526 – Grounding & Bonding: Requirements for bonding
 - 3. Section 260529 – Hangers & Supports: Luminaire support requirements

1.2 SUMMARY

- A. Provide luminaires at all exterior locations indicated on the Drawings. Provide lighting poles where indicated.
- B. Adjust and aim luminaires and verify proper operation.

1.3 DESCRIPTION

- A. Luminaires shall be complete with trim, mounting hardware, drivers and LED modules, and shall be suitable for the location in which they are installed.
- B. Provide all materials required to entirely complete each luminaire ready for use, in accordance with the conditions and requirements of the building construction.

1.4 SUBMITTALS

- A. Product Data: For each type of luminaire, light pole, ballast/driver and lamp/LED module provided for interior and exterior lighting on the Project. Include physical description, materials and finishes, dimensions, weights, accessories, photometry data and efficiency data, as applicable.
- B. Test Reports: Record of all field test data.

1.5 INFORMATION FOR OPERATING & MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Maintenance Instructions: List replacement parts, including source. Indicate recommended and required maintenance and testing procedures and intervals. List all individual lighting components that require periodic maintenance. Identify features, accessory attachments, safety precautions, and procedures for cleaning, lamp replacement and adjustment. Include manufacturer's installation instructions. Detail trouble-shooting procedures, including step-by-step instructions for typical trouble symptoms. Cross out information that does not apply to the Project.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. See schedule on Drawings for listing of required luminaires. Luminaires shall be complete with trim and mounting hardware.
- B. All exterior luminaires shall bear the UL label associated with the type, location, ambient temperature and usage of the individual luminaire. Exterior luminaires shall be enclosed with a gasket, and vapor-tight to provide a seal against ingress of moisture and foreign material.
- C. Drivers shall be completely enclosed in wiring channels arranged to permit easy access. Driver replacement shall not require removing the luminaire from its mounting.

- D. Luminaires shall have finishes applied after fabrication; luminaires manufactured with pre-painted metal are not acceptable.
- E. Luminaires equipped with doors shall be free of light leakage around the doors under normal operating conditions. Doors shall be designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in the normal operating position.
- F. All plastic lenses shall be UV-stabilized virgin acrylic.

2.2 DRIVERS

- A. Each LED luminaire with an electronic driver, shall be provided with a driver of one of the types specified herein, suitable for operation of the indicated Driver voltage rating shall be selected to match circuit voltage.
- B. Drivers shall be fuse protected. Fuses shall be located within the electronics compartment.
- C. LED Drivers: LED drivers to operate with a drive current in the range of 300mA and 1000mA as indicated by specification information in the luminaire schedule. Each driver to be tested with LED module for which it is installed per IESNA LM-79 and LM-80 certification standards. LED drivers to be supplied by luminaire manufacturer, and supplied with the fixture as a tested and certified system.
 - 1. LED drivers shall be available for voltages listed on drawings.
 - 2. LED drivers shall be provided with multi-level control where indicated on drawings
 - 3. LED luminaires indicated as emergency lights on drawings shall be compatible with emergency battery packs that support LED, to be provided by the fixture manufacturer.

2.3 LAMPS

- A. All luminaires shall be complete with LED modules. Light-Emitting Diode (LED):
 - 1. White LED Lamps: Projected rated life shall be 60,000 hours, at 85% lumen output (minimum).
 - 2. LEDs to be driven at nominal drive current for the specified output (300mA-1000mA range) and tested with LED driver as a complete system for which it is installed per IESNA LM-79 and LM-80 certification standards.
 - 3. LEDs used in general lighting applications to utilize phosphor technology.
 - 4. LED color temperature and binning to be within a 3-step MacAdam ellipse.

2.5 ACCEPTABLE MANUFACTURERS

- A. Manufacturers of luminaires shall be as indicated on the luminaire schedule.
- B. Manufacturers of drivers shall be as follows:
 - 1. LED – Phillips Advance, Phillips LED, Nichea, Cree, or as provided/recommended by the luminaire manufacturer. All driver information for alternate manufacturers to be provided in lighting submittal package.
- C. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install luminaires in accordance with the manufacturer's recommendations and installation details.
- B. Provide backboxes matched to luminaires. Where luminaire manufacturer's installation instructions indicate use of standard outlet boxes, boxes shall be in accordance with Section 260533. Back boxes shall be plumb and perfectly aligned.

- C. Mount exterior luminaires at locations indicated on the drawings. Support luminaires in accordance with Section 260529, in the following manner:
 - 1. Mount surface and wall luminaires square with the building lines. Support from fixture stud or as otherwise recommended by the manufacturer. Attach surface luminaires at two (2) support points, minimum.
 - 2. Install recessed luminaires in exterior soffits in accordance such that luminaire weight is supported by structural members. Verify soffit material and thickness to ensure that recessed luminaires can be properly installed.
- D. Mount new luminaires which are located in the immediate vicinity of existing luminaires by the same methods as the existing luminaires. Match mounting heights.
- E. Verify luminaire locations with the Architectural site plan and exterior wall elevations, when such plans and elevations are included in the Contract Documents.
- F. Broken or defective parts shall be replaced, with no additional compensation.

3.2 ADJUSTMENT, TESTING & DEMONSTRATION

- A. Notify the Owner's Representative at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests.
- B. Supply tools, instruments, gauges, testing equipment, ladders, lifts, protective devices and safety equipment for adjustment, testing, and demonstration.
- C. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating & Maintenance Manuals.
- D. Upon completion of the installation, perform the following adjustments:
 - 1. Aim all adjustable luminaires as directed by the Architect's Consultant.
 - 2. Clean reflectors, aperture plates, lenses, luminaire housings and decorative elements. To avoid static buildup on lenses and reflectors, clean with a manufacturer's recommended water-diluted solution of glass cleaner and allow to air-dry.
- E. After adjustments are complete, measure the illumination levels at selected points to demonstrate proper distribution and coverage. Verify with the Architect's Consultant the points where illumination levels are to be measured. Measurements shall be taken at night.
- F. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections, with no additional compensation.

END OF SECTION 26 56 10

DIVISION 27– TELECOMMUNICATIONS

Section 27 08 00	Communications Commissioning	2
Section 27 10 00	Structured Cabling	16
Section 27 13 23	Communications Optical Fiber Backbone Cabling	6
Section 27 51 00	Sound Reinforcement System	5

SECTION 27 08 00 COMMUNICATIONS COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to describe the commissioning process specific for those sections found in Division 27.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. General Responsibilities: The Contractor's commissioning responsibilities applicable to each of the communication contractor, and audio/visual contractors are as follows:
 - 1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - 2. Attend a commissioning kick-off meeting and other meetings necessary to facilitate the Commissioning process.
 - 3. Contractors shall assist in clarifying the installation, operation, maintenance, and control of commissioned equipment if requested by the Commissioning Authority.

1.3 COORDINATION

- A. Refer to Section 019113 for a listing of all sections where commissioning requirements are found, for systems to be commissioned and for functional testing requirements.

1.4 SUBMITTALS

- A. General Submittals: Contractor shall provide to the Commissioning Authority, through established channels, normal cut sheets and shop drawing submittals for all commissioned equipment.
- B. Aid the Commissioning Authority in preparation of the specific functional performance test procedures specified in Section 019113. Subcontractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Checklists: The Contractor shall complete the checklist(s) provided with the Facility Grid app.
 - 1. The completion of these checklists does not limit the Contractor's responsibilities for quality control and scheduling as indicated elsewhere in the documents, nor does this checklist include all submittal, inspection, or quality assurance requirements for the work of this Section.
 - 2. Complete the installation checklists for each component and each system to be commissioned with the Facility Grid app and updated at a minimum of once per week.
 - a. The field technician or installer should complete the updates that will be logged by Facility Grid.
 - b. The installer should be aware of the importance of proper installation and that verification of the installation of components will be on going through out construction by the Commissioning Authority.
 - c. The checklists are available for review by the Construction team and Commissioning Authority at any time by logging in to Facility Grid.

3.2 START-UP ACTIVITIES

- A. General Requirements: Develop a project start-up plan using manufacturer's start-up procedures and the installation checklists for all commissioned components. Submit to Commissioning Authority for review and approval 14 days prior to startup. Refer to Division 01 91 13 for further details on the start-up plan.
 - 1. Notify the Owner's Representative and Commissioning Authority, when communication system testing will occur. Be responsible to notify the Owner's Representative and Commissioning Authority, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction.
 - 2. Coordinate schedule of start-up plan with the HVAC mechanical, electrical and controls contractors. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Authority or Owner.
 - 3. During the startup and initial checkout process, execute the portions of the installation checklists for all commissioned components.
 - 4. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Architect and Commissioning Authority.
 - 5. Provide skilled technicians to execute starting of components. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.

- 3.3 Pre-Verification Testing (PVT): The Contractor will perform the Pre-verification tests as provided with the Facility Grid app. The PVT's will be done on all equipment and systems outlined in Division 01 91 13. When all pre-verification testing has been completed, the CA will schedule Functional Performance testing and substantial completion may be issued.

3.4 CLOSEOUT ACTIVITIES

- A. Training: The Owner personnel shall be trained on procedures listed in 1.1A above.
 - 1. Provide results of all manufacturer recommended tests, conductivity tests, and correction sheets for systems installed in this Division.
- B. Operation and Maintenance Manuals: The approved complete manuals must be on site prior to training.
 - 1. For additional O and M related requirements, review Division 1.
- C. Training: The Owner personnel shall be trained on procedures related to the list in 1.1A above.
 - 1. For additional training related requirements, review Division 1.

3.5 DOCUMENTS REQUIRED

- A. The General Contractor will provide the following documentation before Final Acceptance:
 - 1. Completed Inspection Forms with approval signatures of all Authority Having Jurisdiction.
 - 2. Approval Signature of Electrical Engineer
 - 3. Copies of Completed Data Conductivity Tests submitted.
 - 4. Provide test results of Audio/Video Conductivity. Use Manufacturer's test forms.
 - 5. Provide tests results for Public Address and Intercom System. Use Manufacturer's test forms.

END OF SECTION

SECTION 27 10 00- TELECOMMUNICATIONS CABLING SYSTEM

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.
- B. Division 26, Basic Materials and Methods sections apply to work specified in this section.

1.2 REFERENCE STANDARDS

- A. ANSI/TIA-568.0-D – Generic Communications Cabling for Customer Premises
- B. ANSI/TIA-568.1-D – Commercial Building Communications Cabling Standard
- C. ANSI/TIA-568-C.2-1 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- D. ANSI/TIA-569-D – Telecommunications Pathways and Spaces
- E. ANSI/TIA-606-B.1 – Administration Standard for the Commercial Telecommunications Infrastructure
- F. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- G. ANSI/TIA-862-B – Structured Cabling Infrastructure Standard for Intelligent Building Systems
- H. ANSI/TIA-942-A – Telecommunications Infrastructure Standard for Data Centers
- I. NFPA 70 – National Electrical Code (NEC)
- J. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.3 GOVERNANCE

- A. The Electrical Code referred to in these specifications is the National Electrical Code as currently adopted by the State of Washington. All work will be provided in strict compliance with the Electrical Code and all regulations that may apply.
- B. Where standards exist, for a particular category, products used on this project will be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL), and be approved or listed for the intended service and application.
- C. These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The stricter, higher quality, greater quantity or higher cost will be allowed, and accommodations must be approved by Owner prior to procurement or installation. It is incumbent on the Installer, material and equipment suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.
- D. The word "Manufacturer" will include the Manufacturer, the Manufacturer's Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.
- E. All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards the Specifications will govern:
 - 1. State Building Code (SBC)
 - 2. Building Department Inspectional Services
 - 3. American Society for Testing and Materials (ASTM)
 - 4. Underwriter's Laboratories, Inc. (UL)
 - 5. Insulated Cable Engineers Association (ICEA)

6. National Electrical Manufacturers Association (NEMA)
 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 8. American National Standards Institute, Inc. (ANSI)
 9. National Fire Protection Association (NFPA)
 10. Local Electric Code
 11. Department of Public Safety (DPS)
 12. Building Officials and Code Administrators International, Inc. (BOCA)
 13. Department of Labor USA. Safety and Health Regulations for Construction (OSHA)
 14. Energy Codes
 15. National Electrical Contractors Association (NECA)
 16. National Bureau of Standards (NBS)
 17. Federal Communications Commission (FCC)
 18. Utilities Serving Project
 19. Fire Department
 20. Americans with Disabilities Act Applications Guidelines (ADAAG)
 21. Accessibility Guidelines for Buildings and Facilities
 22. Any and all Federal, State and Local Standards, Codes and Authorities having Jurisdiction
- F. In addition, all phases of the Structured Cabling System installation will adhere to applicable Local Area Network (LAN) Specifications of the IEEE, Electronics Industry Association/Telecommunications Industry Association (TIA/EIA), and Building Industry Consulting Service International (BICSI). The entire system and all components will be Nationally Recognized Testing Laboratory (NRTL) certified to appropriate TIA/EIA performance rating Category, Latest ANSI/TIA/EIA Standards 455-A, 492, 568, 569-A, 570, 606, 607 and 758 (latest revisions), and ANSI/TIA TSB 67, TSB 72, TSB 75, TSB 95 plus other standards as applicable.
- G. The Installer will have available at the job site at all times one copy of the latest edition of the Electrical Code, TIA and BICSI Standards applicable to the work as specified within this document.
- H. The above requirements will not in any way limit responsibility or requirements to comply with all other codes, standards and laws.
- I. Material, equipment, enclosures, and systems will be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.
- J. All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.
- 1.4 DESCRIPTION OF WORK
- A. The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, cable supports, raceway, connectors, racks, cabinets, panels, wire management, device plates, backboard, grounding, firestop and miscellaneous items required for a complete, tested and operational system.
- B. Provide, install and test the complete cable and outlet system as indicated and described herein. Work includes procurement, project management, installation, labeling, termination, testing and cleanup of all cables installed under this project.
- C. Provide system testing, as-built drawings (redlines) of installed cables and numbering plan, Operations & Maintenance Manuals (O&M's), and processing of warranty registration with Manufacturer.
- D. Project coordination with General Contractor, Owner's Representative, and other trades before, during and upon completion of project as necessary for a well-executed project.
- E. Refer to other Master Division sections, bid proposal and project responsibilities matrix for responsibility and requirements for raceways, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.
- F. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

- G. Horizontal copper cabling system consists of four twisted pairs of solid annealed copper. Each four-pair cable is terminated onto 8 position 8 conductor ("RJ45", or 8P8C) connectors (jacks) using Insulation Displacement Conductors (IDCs). Color-coded connectors are placed into NEMA rated faceplates at the work area and placed into corresponding rack-mounted patch panels in the equipment / networking rooms. The jacks use state-of-the-art techniques to effectively eliminate Alien Crosstalk.
- H. Horizontal cabling may contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
- I. Bridged taps and/or splices will not be installed in the horizontal cabling.
- J. Communications cables shall be rated CMR or CMP. CMP cable ratings are required for cables passing through or contained within plenum air handling spaces, such as above drop ceilings and return or supply air shafts. The contractor is responsible for installing the correct cable type in the appropriate environment, and any failures to do so per Owner or the Authority Having Jurisdiction (AHJ) will result in the contractor removing the unsuitable cable and installing the correct cable, at their own expense.
- K. The maximum allowable horizontal cable length installed in the permanent link (jack to jack) is 295 feet (90 m). This maximum allowable length does not include an allowance for patch cords, maximum length of 16 feet (5 m) to the workstation equipment and of 16 feet (5 m) in the horizontal cross-connect.

1.5 QUALITY ASSURANCE

- A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials, which have been UL-listed and labeled. Comply with NEMA, ANSI and TIA standards manufacturer's recommendations for horizontal cabling.

1.6 SUBMITTALS AND SUBSTITUTIONS

- A. Owner has standardized on a unified, end-to-end copper cabling system design based on CommScope. Owner is satisfied that the products specified herein are qualified for the purpose intended, and has performed due diligence in establishing a consistent set of standards based on performance and feature set.

1.7 CONTRACTOR QUALIFICATIONS AND TRAINING

- A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
 - 1. Possess a valid Washington EL06 Contractors License.
 - 2. The contractor shall have a minimum of 3 current CommScope qualified technicians in the local area with (250 miles) of where the work is being performed.
 - 3. Personnel trained in the installation of pathways and support for housing horizontal cabling.
 - 4. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
 - 5. Been in the Low Voltage or Telecommunications Installation business for a minimum of 5 years.
 - 6. All Licensing and certification documents must be available, and submitted before the time of bid.

1.8 WARRANTY

- A. A CommScope Limited Lifetime Product & Performance Warranty covering all components, equipment and workmanship shall be provided to Owner, submitted in writing with system documentation.

1. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to Owner.
 - B. Certified Installer shall provide labor, materials, and documentation in accordance with CommScope requirements necessary to ensure that Owner will be furnished with the maximum available Manufacturer's Warranty in force at the time of this project.
 - C. The installed structured cabling system shall provide a warranty guaranteeing the specified performance in the installed channel performance above the ANSI/TIA-568 requirements for Category 6 or ISO 11801 requirements for Class EA.
 - D. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer.
 1. Certified Premier Contractor must adhere to the terms and conditions of the respective manufacturer's warranty programs.
 2. Shall include a copy of all licensing and certification documents in deliverable package.
- 1.9 PRODUCTS INSTALLED BY DIVISION 26
- A. All conduit and EMT required for Communications cabling pathway in/out of cross connect closets and in/out of wall cavities at the work area. EMT or Conduit for pathways shall have no more than two 90 degree bends between pull boxes and no continuous section over 100'.
 - B. All core holes through concrete, metal, finished hardwood or masonry; in-floor troughs ("Walker Duct"), and poke through devices in the floor for the installation of Communications cabling. Device plates for landing communication cables should be included in the Communications scope.
 - C. All core holes and EMT sleeves between floors for the routing of Communications cabling.
 - D. Back boxes for the mounting of NEMA rated faceplates.
 - E. Drag line or pull string at the back boxes fished through existing EMT, conduit, or wall cavities ("Ring and String") to the accessible ceiling or other end of conduit, for installing horizontal cables.
 - F. Unless otherwise noted a minimum of 2 walls covered in 3/4" AC grade plywood painted white with fire retardant paint in each cross connect closet or connection point for data, voice, video, security and building automation systems. Plywood walls shall be covered 4' W x 8' H whenever possible.
 - G. Unless otherwise noted basket tray or ladder racking to support main pathway cable bundles through hallways, open areas or exiting telecom rooms unless otherwise requested at time of bid.
 - H. Unless otherwise noted #2/0 ground wire or other size as appropriate, from Telecommunications Grounding Bus Bar(s) to Building Ground. Use of #6 ground wire, or smaller as allowed, for grounding of telecommunications equipment installed under this Scope is included within the Telecommunications scope of work.
 - I. Provide complete raceway, outlet boxes and miscellaneous items as required.
 - J. Utilize 4-11/16" square outlet box (min) at each outlet location with single gang plaster or tile ring and 1" conduit to cable tray, backboard, or accessible ceiling or floor space.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete data cabling and device system as described herein.
- B. Work area connectors shall be of a non-proprietary "Keystone"-style port configuration, such that they fit into all furniture, panels, wall plates, raceways, floor monuments, poke-throughs and AV boxes without adapters. Maximum density of 6 outlets shall be available in Decora footprint where required.

2.2 ACCEPTABLE MANUFACTURER SOLUTIONS

- A. Subject to compliance with requirements, provide products of the following:
 1. CommScope, Inc

2. Substitutions: Under provisions of Division 01.

2.3 UTP PIN/PAIR TERMINATION ASSIGNMENT

- A. The UTP cabling system will have TIA/EIA T568B pin/pair termination assignment. All conductors provided will be properly and consistently terminated at both ends throughout the entire systems. Maintain proper untwist of pairs and removal of jacket per TIA, BICSI, and Manufacturer's recommendations.
- B. Category 6 Unshielded Twisted Pair (UTP) Systems
1. Category 6 UTP 24AWG copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.
 2. Category 6 Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
3%	3 dB	3 dB	3 dB	5 dB	2 dB	3 dB	5 dB

2.4 HORIZONTAL CABLING SYSTEMS

- A. Category-Rated Data Connectors (RJ45 Jacks)
1. Provide modular-type, information connectors/outlets (jacks) for 24-23 AWG copper cable. These connectors shall be individual snap-in style, and exceed compliance with TIA-568 specifications. The connectors shall comply with the following:
 - a. Shall be 8-position 8-conductor (8P8C) "RJ45"-style modular jack, Category 6, with IDC terminals, T568A/B wiring scheme (use T568B).
 - b. Shall be encased in a die-cast housing to protect from potential EMI/RFI, and utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.
 - c. Category 6 Connectors shall exceed all component performance requirements for Category 6 in the ANSI/TIA-568-C.2 standard, as well as Class E requirements as described in ISO/IEC 11801, from 1 MHz to 250 MHz.
 - d. Shielded connectors shall utilize the same form factor, design, and tool-less installation process as the unshielded connectors in the product line.
 - e. Shall be tested by an Independent testing body such as Intertek (ETL) for component compliance (i.e. "Component rated") to ANSI/TIA-568 and for POE+ applications. Test results shall be published and publicly available without special request.
 - f. Shall be in compliance with all National Electrical Codes; compliant with ANSI/TIA-1096-A (formerly FCC Part 68); UL Listed.
 - g. When used in the plenum spaces, shall be plenum-rated per UL 2043, and all plastic components shall be made of high-impact, fire-retardant plastic rated UL 94V-0.
 - h. Shall have a maximum depth of 1.31".
 - i. Cable shall be terminated by the use of a snap-on wire manager that holds individual conductors in place during termination, and allows for termination without a complete untwist of each conductor pair. Cables shall terminate onto jack via a "clamshell" closure at rear of connector, affixing termination manager to connector IDC.
 - j. Shall be terminated without the need for any punch down tool or other specialized or proprietary termination tool.
 - k. Shall be reusable and support a minimum 20 termination and re-termination cycles and be facilitated by simple termination release levers.
 - l. Shall utilize a method of tine tensioning using polymer springs above the tines ("Retention Force Technology" or similar functionality) that prevents six-position modular plug insertion from damaging either the cord or the module and promotes return of tines to original position.

- m. Shall fit the full manufacturer's range of telecommunications faceplates, outlets, and field-configurable patch panels. No separate product line or style of connectors shall be required for patch panels, faceplate, biscuit, furniture, raceway and/or floor feed applications.
 - n. Shall be available in 13 TIA 606-B compatible colors and supplied with interchangeable icons (Voice, Data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions. Additional bulk Icons for the connector shall be available separately.
 - o. Shall be available with an optional internal shutter to protect against dust and debris such as in above-ceiling and in-floor locations.
- B. Patch Panels
 - 1. Telecommunications Room Patch panels shall be manufactured with industry-standard modular non-loaded jack type and shall hold 48 Category 6 terminations. Panels shall be:
 - a. All 48 ports.
 - b. Mount in 2RU space.
 - c. Shall be sized to fit an EIA standard, 19-inch relay rack and hole pattern.
 - d. Shall come blank so the appropriate colored jacks can be installed.
 - 2. Manufacturer CommScope – 48 port, Part No. 760162818.
- C. Faceplates
 - 1. Faceplates (wallplates) secure information outlets to the work area. Contractor shall provide and install single gang faceplate kits to house all jacks as required for all work area outlets, workstation base feeds, and furniture openings. Unused telecom backboxes shall receive a solid blank faceplate. Telecommunications faceplates shall:
 - a. Utilize a keystone-type ("QuickPort") footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
 - b. Stainless steel manufactured to hold 8P8C modules with recessed strips with clear plastic covers per TIA-606-B labeling standard. Manufacturer Semtron – 4/6-Port Part No. 1FM-(4/6)0E-LAB-AMP or equivalent.
 - c. Support any connectivity media type, including AV and copper applications.
 - d. Have printable designation labels for circuit identification together with a clear plastic cover.
 - e. Be available in single-gang and double-gang configurations.
 - f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
 - g. Have single-port matching color blank inserts available in packs of 10.
 - h. Color shall match nearby electrical devices exactly.
 - i. Furniture faceplates shall fit existing knockouts for telecom receptacles, and snap in without screw mounts.
- D. Surface-Mount Box (SMB)
 - 1. Surface-Mount Box (SMBs) are used to protect terminated Category 6 cables at the endpoints where they are not contained within walls or furniture. Example locations may be Wireless Access Points (WAPs), Group Work Areas fed by conduits run down columns, security cameras, or other network-enabled device locations.
 - 2. Unless otherwise noted all wireless access point (WAP) shall consist of two category 6 jacks (2) and a single 2-port plastic SMB.
 - 3. Small Surface-Mount Boxes shall exhibit the following characteristics:
 - a. Outlet housings for WAPs and other devices shall be a high-density, low profile design with (2) field-configurable ports, snap-lock cover, and cable knockouts on back.
 - b. Housing cover shall have raceway knockouts for top and bottom entry.
 - c. Base shall include Tie-wrap anchor points at all cable entrances.
 - d. The housing shall be mountable with screws, tape or a single magnet.
 - e. The cover shall provide the option of securing it to the base with a screw that is hidden under the outlet identification window.

- f. Shall be constructed of high-impact self-extinguishing plastic rated UL 94V-0, and be UL Listed and compliant with FCC Part 68 and TIA-568 specifications.
 - 4. Manufacturer CommScope – Part No. 1-1933668-3
- E. Data Cables
 - 1. Category 6 ,100-Ohm, 24 AWG, Category 6 4-pair balanced unshielded twisted pair solid annealed copper conductors,
 - 2. Cable shall be characterized to 500 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class E.
 - 3. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
 - 4. Outer Diameter: 0.224" max.
 - 5. Cable shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.
 - 6. All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
 - 7. Cable may be CMR rated for areas not running through air handling spaces. CMP cable must be used if cable passes at any point through an air plenum or supply/return air handling space.
 - 8. Manufacturer CommScope, White, Part No. UN874049714/10

2.5 FRAMES, RACKS, AND CABINETS

- A. Floor-Mounted 2-Post Racks
 - 1. Universal junction hole pattern matches most manufacturers racks. #12-24 panel mounting holes. UL Listed (File No. E140851) as a communications circuit accessory.
 - 2. Load Rating: 1000 Lbs. weight capacity when evenly distributed for the height of the rack (84" and shorter).
 - 3. Add (1) front/rear vertical wire manager on each side or between racks. See Wire Management, below.
 - 4. Permanently stamped rack mount unit (RMU) markings included. Double sided universal (5/8", 5/8", 1/2") mounting spacing.
 - 5. Includes fifty (50) pilot point #12/24 mounting screws.
- B. Vertical Wire Managers
 - 1. Provide full height, front-and-rear, 6"-8" wide Vertical Wire Managers at the side of and between each 2-post and/or 4-post termination rack or frame. If space will not allow, the 5" wide wire manager may be substituted at row ends only, leaving the 8" vertical wire manager between each rack. Owner approval in writing is required prior to this substitution.
 - a. Mounting hardware shall be included to insure the proper installation to infrastructure. It shall mount onto a standard TIA/EIA recognized equipment rack.
 - b. The management system shall offer an assortment of accessories, including a bend radius slack loop organizer, cable retainers, and shall accommodate top, bottom, side and pass-through cable routing. Dual hinged, cable concealing covers shall be included.
 - 2. Approved Products:
 - a. Chatsworth (CPI)
- C. Horizontal Wire Managers
 - 1. Provide 2RU Metal 5 ring horizontal wire managers with doors above and below or between every 2RU of patch panel, as space allows.
 - a. Do not coil or wind patch cords inside wire managers.
 - b. Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

2.6 CABLE SUPPORTS

A. J-Hooks

1. All cable shall be supported above ceiling on dedicated cable support hardware.
2. Cable saddles and J-hooks shall be used where cable tray or wire basket is not available. These must be supported on their own ceiling wires, threaded rod, or affixed to building structure by use of beam clamps (on metal beams) or wood screws (on wood beams). Affixing communication cable supports to ceiling support wires and conduit is not allowed.

B. Cable Tray

1. In Telecom Room, cable tray (ladder runway) shall be installed to support all cable running to racks and cabinets.
2. Cable tray shall be aluminum, with 12" rung spacing.
3. Cable shall be combed and bundled in all exposed runs outside walls, in TR/TE, and inside cabinets and wire managers.
4. All appropriate cable tray support hardware including angle brackets, rack-to-runway brackets, wall-to-runway brackets, elevation kits, junction splices, butt splices, and grounding jumpers shall be used for a complete and professional installation.

C. Jack/Outlet Brackets

1. Above-ceiling cable termination locations shall be either wall-mounted or suspended from structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or equipment above ceiling grid.
2. For Wireless Access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware.
3. Two category-rated jacks may be installed in each above-ceiling bracket. Each above-ceiling bracket will hold a 2-port Surface-Mount Box or 1-U MOS SMB for multimedia applications.
4. For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.
5. One category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) category-rated jacks, (2) in-wall brackets must be used.

2.7 FIRESTOPPING

A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall:

1. Meet the hourly rating of the floor or wall penetrated.
2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
3. Permit multiple devices to be ganged together to increase overall cable capacity.
4. Allow for retrofit to install around existing cables.
5. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.
6. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - a. Opening or closing of doors.
 - b. Twisting an inner liner.
 - c. Removal or replacement of any material such as sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
7. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

8. Where non-mechanical products are utilized, provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
 - a. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
 - b. Utilize an EMT sleeve as a stub through all walls.
 - c. Surround annular space between EMT sleeve and wall material with a hardening intumescent caulk.
 - d. Utilize re-enterable, non-hardening putty around cables inside a metal sleeve. Do not exceed 40% fill capacity of sleeve and follow all rated assembly requirements per Manufacturer, local codes, and AHJ.
 - e. All sleeves to be install by Division 26.
9. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier

2.8 LABELING

A. Cables

1. Horizontal cables shall be labeled at each end according to Owner labeling standards (see below). The cable or its label shall be marked with its identifier.
2. Cable labels shall be machine-generated wrap-around labels with multiple cable ID's printed such that it can be viewable in place without turning the cable.
3. Label cables within 6" of termination point at both ends.

B. Faceplates

1. A unique location identifier shall be marked on each faceplate to identify its location in the cable plant.
2. Each port in the faceplate shall be labeled with its own unique identifier.

C. Racks, Panels, and Blocks

1. All grid locations that are slated to be used for wireless access point drops above ceiling grid need to be labeled with black on blue TZ type label tape to identify location of drop.

2.9 APPROVED PRODUCT LIST

A. Category 6 Modules:

1. 8-position 8-conductor modules shall be category 6, universal T568A/B pin configuration standard used to terminate Category 6 UTP cables.
 - a. Manufacturer CommScope NetConnect:
 - 1) District Network, White, Part No. 1-1375055-3
 - 2) AV Network, Blue, Part No. 1375055-6
 - b. Blank module in package of 10, White, Part No. 1116412-3

PART 3 - EXECUTION

3.1 CABLE HANDLING / CABLE MANAGEMENT

A. Proper cable handling is critical to maintaining the design integrity of high-performance cabling. Cable handling recommendations include:

1. Cable must be conditioned above 32 degrees F for 48 hours prior to installation.
2. Do not use excessive force when pulling cable. The maximum pull-force guideline for a 4-pair horizontal UTP should not exceed 110N (25lbf). Meeting this guideline avoids stretching conductors during installation and the associated transmission degradation.

3. The minimum bend radius for UTP should not exceed 4 times the cable outside diameter (O.D.)
4. Traditional bundling of Category 6 cabling for a combed appearance is required in all exposed locations.
5. In telecom room, use appropriate horizontal cable management for patch cords on front of patch panels. Also, use appropriate cable management bar(s) for support of terminated horizontal cable.
6. Do not use vinyl or plastic cable ties due to the potential for over-cinching of cable bundles which can alter the cable geometry and degrade the system cabling performance. Use only hook and loop ("Velcro") fasteners for bundling of horizontal cables.
7. Store cable slack in an extended loop configuration to alleviate cable stress. Excessive cable slack in bundled loops or traditional 'service loops' to provide additional cable length in TR has been shown to degrade cabling performance and are not recommended.

3.2 SEPARATION OF DATA AND POWER CABLING

- A. Design cable pathways to avoid potential sources of EMI. Avoid installing cable near sources of EMI (X-ray equipment, large motors/generators, electrical power cabling and transformers, Radio frequency (RF) sources and transmitters, lighting, copiers, etc.).
- B. Physically separate power & data cabling according to relevant code and standard requirements when run in a common pathway.
 1. Never run data and Class 1 power cabling in parallel closer than 2".
 2. Avoid crossing cables if possible. If necessary, always cross cables at 90 degrees.
 3. Maintain a minimum of 5 in. separation between data cable and all ballast controlled lighting.
- C. Minimum separation distances of telecommunications cabling from potential sources of EMI exceeding 5kVA:
 1. 24" away from Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.
 2. 12" away from Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway.
 3. 6" away from Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway.
 4. 48" away from Electrical motors and transformers.

3.3 INSTALLATION OF STRUCTURED CABLING SYSTEM

- A. Pre-Installation Conference
 1. Schedule a conference a minimum of five calendar days prior to beginning work of this section.
 2. Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.
 3. Attendance: Communications system installer, General Contractor, Owner's Representatives and any additional parties affected by work of this section. Owner's Information Technology must be represented at a preconference meeting prior to scheduling of any work.
 4. Copy of warranty application will be provided by Contractor.
 5. Pre-Installation conference may be waived only by Owner.
- B. Warranty
 1. A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the system's first use by Owner.
 2. Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.
- C. Drawings and Specifications

1. The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his or her responsibility of properly completing the Contract.
 2. Owner's Project Manager has the option of changing the location of Electrical and Communication outlets to within 3 meters of designed location prior to rough-in stage at no extra cost to Owner. Owner and Owner's Representative requests a chalk/rough-in walk prior to installation to verify locations.
 3. The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions and to coordinate and provide a chalk/rough-in walk prior to installation to verify locations.
 4. The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final workstation outlet locations.
 5. Where conflict exists between drawings and specifications the Contractor shall, make allowance for provision of the component, system, or installation process in a manner which will provide the highest monetary cost components, systems, or installation process. Contractor shall inform Owner's Project Managers of the conflict and obtain approvals prior taking corrective measures.
- D. Requirements and Standards
1. Unless otherwise noted a minimum of 1 Category 6 UTP cable and jack shall be installed in all work area outlet (with the exception of wireless access points) locations on a 4-outlet flush mounted faceplate, including offices, utility services, and other common telecommunications locations. The two center positions are to remain blank for future use.
 2. Two (2) category 6 UTP cables and jacks shall be installed at all Wireless Access Point locations.
 3. All termination wiring shall be T568B termination pattern.
 4. A minimum of 2 each 4" inch sleeves must be installed in telecom room for the first one hundred cables. 2 each additional 4" sleeve must be install if the cabling count exceed 100 cables and 2 additions per hundred from there (example: 120 cables will require 4 each 4" conduits while 220 cables will require 6 each 4" conduits).
 5. Sleeves for penetration of walls and floors shall have a one hundred percent (100%) spare capacity and shall be fire-stopped as per code.
 6. All sleeves shall be installed by Division 26.
- E. Pathways and Topology
1. Utilize "thin film" lubricants only! It has been shown that cable-pilling lubricants will affect testing as the cable needs several weeks to dry before attenuation levels recover. Use of incorrect cable lubricants will erode cable jacket and void cable warranty.
 2. All cable and wire shall be concealed in conduits, floor ducts, paneling, ceiling or similar areas except at mutually agreed upon areas.
 3. Fill capacity in conduit, modular furniture and other horizontal pathways should not exceed 40%. A maximum of 60 % pathway fill is allowed to accommodate unplanned additions after initial installation. To calculate the fill ratio, divide the sum of the cross-sectional area of all cables, by the most restricted cross-sectional area of the pathway.
 4. Flat-rung and/or solid bottom cable tray shall be utilized for large, high-density installations. J-hooks and other specific cable support hardware shall be used at all locations outside of cable tray.
 5. Pathway design should not exceed (2) 90-degree bends between pull points or pull boxes (PB). If more than (2) 90-degree bends are required, install a pull box between bends.
 6. Provide NEC-sized pull boxes for any run greater than 100 feet, or with more than two ninety-degree bends.
 7. J-hooks should be randomly spaced 60" or less. Do not exceed J-hook capacity for size and weight limitations.

8. Land wireless access cabling above ceiling, secured onto in-ceiling bracket. A slack loop in the horizontal cabling is not required. Utilize varying-length patch cords when installing wireless access point devices for flexibility in length.
9. Crimp-on modular plugs at wireless access points are not allowed. Terminate all category 6 cabling onto the approved jacks.
10. Mixing of various Category cables in the same pathway is allowed if the applications are appropriate for each category of cable used.
11. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.
12. Maintain a distance of at least 12 inches from all power conduits and cables. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.
13. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
14. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in telecom room, such that no drilling of additional sleeves/slots is necessary. Sleeves may need to be provided and installed under the scope of this Project.
15. For voice or data applications, 4 pair UTP cables shall be run using a star topology from the telecommunications room to every individual information outlet.
16. Horizontal pathways shall be installed or selected such that the minimum bend radius is maintained both during and after installation.
17. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
18. Install $\frac{3}{4}$ " x 4' x 8' fire-rated plywood across all walls in telecom rooms, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.
19. Contractor (shall firestop all used pathways which enter or leave the telecom room via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire-rated walls.

F. Grounding

1. Refer to Section 270526 for specifications on Grounding and Bonding.
2. All grounding (earthing) and bonding shall be done to applicable codes, standards and regulations.
3. Shielded cabling channels shall include appropriate method of bonding shield to approved ground for proper EMI/RFI mitigation.
4. Shield Continuity Testing shall be enabled when shielded cabling channels are installed.
5. All shielded and armored cables shall be bonded to a telecom grounding system via shielded patch panels at the rack locations. Shielded Category-rated connectors must be properly installed to maintain electrical ground conductivity along entire length of cable and at both ends of the cable. UTP connectors shall not be used on shielded cables at either end.
6. Shielded Patch cords shall be provided for use and employed at each workstation location utilizing shielded cable. Shielded patch cords can be identified by their gray color and metallic RJ45 plug. Shielded patch cords are not required at the patch panels.
7. Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at telecom rack location. All ground lugs shall be 2-hole make-up.
8. Division 26 will provide the all bus bars and the connection between the TGB and building ground.

9. Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar within the telecom room.
- G. Cables and Terminations
1. Check plans for final determination of faceplate colors or consult with the Electrical Engineer prior to install.
 2. Install additional cables at drop locations and in quantities indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.
 3. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
 4. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).
 5. The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP cable during handling and installation.
 6. No run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall contain splices.
 7. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling. Minimum 6" is preferred.
 8. J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports. Cables shall be supported by dedicated low-voltage cable support hardware. Support of cables or hanging hardware by means of supports or surfaces related to other trades or applications is not allowed.
 9. Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.
 10. Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables.
 11. Comply with ANSI/TIA-569 for conduit and splice box sizing.
 12. Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings. Do not "split pairs" between different jacks.
 13. Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed their associated Category rating as specified above.
 14. For enclosed ceiling WAP locations, install and terminate two category 6 (2) cables to approximate location as shown on plans. For open-ceiling environments, secure cables and surface-mount boxes to nearest appropriate support structure.
 15. For in-ceiling WAP locations, secure jacks inside a surface-mount block mounted to in-ceiling metal assembly, and provide a 5' patch cord or longer, as needed, to connect device to its final determined location in ceiling.
 16. Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.
 17. Extreme care must be taken not to nick any of the copper conductors when removing jacket. Use rip cord to expose pairs for termination onto Insulation Displacement Contacts. Precision strippers with adjustable blade depths may also be used.
 18. Maintain twists as close as possible to the point of termination. Untwisting of copper pairs should not exceed 1/4" to the termination point.
 19. Manage the cable bundles in a symmetrical orientation. For example, in a 48-port patch panel, distribute 24 cables through the vertical cable management on the left rear side of the rack and 24 cables through the vertical cable management on the right rear side of the rack.
 20. Do not dress cables in bundles larger than 24 cables. Multiple 24-cable bundles may be run in parallel with evenly-spaced Velcro cable ties in an orderly sequence.

21. For cable management on rear of patch panel, cable shall sweep into termination points and be supported by appropriate rear cable management.
 22. Horizontal patch cord management is required on all installations.
 23. Maintain cable bend radius 4X outer diameter (UTP only) when mounting faceplate onto EMT backbox, box-eliminators or furniture knock-outs.
 24. Faceplates and SMBs shall be fully installed and labeled prior to testing.
- H. Above-Ceiling and Wall-Mounted Wireless Points and Devices
1. All WAP locations shall receive (2) Category 6 cables from telecom rack. Multimedia, security and other video devices shall receive (1) Category 6 cables as shown on drawings, documents and details.
 2. WAP and other communications cables shall terminate on patch panels in the telecom room. WAP cables shall terminate on Category 6 information outlets and shall be terminated above the ceiling in a 2-port SMB.
 3. SMB, jacks, and patch cords used in plenum spaces shall be plenum-rated.
- I. Terminal Blocks and patch Panels
1. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.
 2. Dress and comb all incoming cable bundles in groups of 24 cables each. Eliminate crossed cables and "divers".
 3. Ground all shielded patch panels to telecom ground source via paint-piercing washers to a grounded rack, or via direct ground wire to telecom bus bar.
- J. Telecom Room
1. The rooms shall be able to contain data or telecommunications' equipment, cable terminations and associated cross-connection wiring. Closet spaces are not to be shared with electrical installations, other than those directly for telecommunications, video, security and information systems equipment. The rooms are not to be shared with other unrelated building service, for example plumbing. Any conflicts with these specifications require the approval of Owner's project manager.
 2. Contractor shall submit a drawing of the telecom room showing layout of all components including necessary and required electrical outlets, conduits, environmental requirements and wire termination fields prior to start of the job. Any jack densities noted in these specifications are estimates only. The drawing will designate the most effective, scalable, jack termination cabling design to facilitate data/telecom outlets shown on the lease exhibits. Owner's Project Managers must approve drawings prior to installation.
 3. All racks, panels, and equipment finished shall be anchored to meet local seismic zone requirements and industry standards. The equipment racks are to be anchored to the concrete floors via "Unistrut or equal metal framing strut systems", threaded rod, concrete anchors, bolts and washers.
 4. The overhead cable ladder system will provide a route for the Category 6, and other communication cables while providing stability to the equipment racks.
 5. The vendor is responsible to provide and install the specified count of 19" EIA rack-mount 7' (45U) 2- post racks. The vendor is responsible for submitting layout drawings to Owner for approval prior to installation.
 6. The contractor shall provide high capacity horizontal and vertical cable manager channels are required in all data and equipment racks, and the racks will contain sufficient vertical and horizontal cable managers to facilitate the patch panel density and placement installed by the contractor.
 7. Contractor will install raceways, boxes, managers, and enclosures as indicated according to manufacturer's written instructions. Securely fasten each component to the surface to which it is mounted and remove burs and sharp edges from all cable tray.
 8. A ladder rack system is required and will be provided by the contractor and installed in the telecom room to provide cable support to the rack system. This includes all the required ladder rack support items such as rack to runway kits, wall angle brackets, ceiling supports, splices (junction and butt), radius drops and j-bolts. The final ladder rack layout will be included in the telecom room layout drawing described above.

9. Provide and install as needed, 4' x 8" x 3/4" fire-rated plywood board and labeled with fire rating stamp facing into the room to accommodate rack ladder support, cabling support, grounding platform, data and voice equipment. Paint backboard white (leave stamp visible) to match existing backboard in room, if appropriate. Location of installation is to be determined with approval by Owner.

K. Patch Cords

1. Owner Furnished Owner Installed (OFOI)
 - a. Install Category 6 patch cords at the equipment cabinet between Category 6 patch panel and Owner switches. Dress and bundle patch cords as appropriate for final installation.
2. Contractor Furnished Contracted Installed
 - a. If the wireless access points are part of the proposal, then the contractor will be required to install Category 6 patch cords between the work area outlet and the wireless access points. Neatly route, dress and bundle patch cords to assure they are esthetically please for Owner if patching is done by the contractor.
3. Labeling
 - a. Provide machine-generated labels appropriate for all components supplied and installed. Under no circumstances shall hand written labels be used.
 - b. Each faceplate, cable, or data outlet (drop) will be numbered with a unique identifier clearly indicating the voice and data jacks by Closet ID, Rack ID, Panel ID, and Port ID.
 - 1) Ex: 128.1.A-24 (IDF 128 / Rack 1 / Panel A / Port 24)
 - 2) Label at the panel to match
 - c. The labeling scheme shall not include duplicates of any new or existing cable identification across the entire cable plant.
 - d. Labeling procedure will meet TIA-568, TIA-606 (Class 2 Administration) and BICSI Standards.
 - e. The labeling scheme will be provided at all locations within the cable infrastructure.

3.4 TESTING

A. Copper Testing

1. Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.
2. Tester is to be a Level IV device or better, and configured with the specific cable installed, and the Permanent Link test will be performed according to the Category's standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.

B. Test Results

1. Repair and resolve any shortcomings in the test results. Mitigation efforts may require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.
2. Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.
3. Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.
4. Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.
5. Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).
6. The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.

7. After the installation is complete, in addition to any other required testing as described herein, and at such times as Owner/Engineer directs, the Contractor shall be present while Owner conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.
8. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.
9. Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.
10. Test results shall be provided in both native Tester format as well as comma separated variable (.csv), Portable Document File (.pdf), plain text (.txt), or hypertext markup language (.html/.htm). A copy of the tester native test software must be provided to Owner or Owner's representative for comparison of results.
11. Test Results for CATEGORY 6 shall include the following:
 - a. Applicable room number of jack location (room number per Contract Documents)
 - b. Applicable Telecommunications Room number
 - c. Circuit I.D. number with corresponding jack identifier
 - d. Wire Map – shall include the following:
 - 1) Continuity to the remote end
 - 2) Shorts between any two or more conductors
 - 3) Crossed pairs
 - 4) Reversed pairs
 - 5) Split pairs
 - 6) Any other mis-wiring
 - e. Length
 - f. Insertion Loss
 - g. Near-end Crosstalk (NEXT) Loss
 - h. PS-NEXT (Power Sum Near End Cross Talk)
 - i. FEXT (Far End Crosstalk)
 - j. ELFEXT (Equal Level Far End Cross Talk)
 - k. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)
 - l. Propagation Delay
 - m. Delay Skew
 - n. Return Loss
 - o. PSFEXT (Power Sum Far End Crosstalk)
 - p. PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)

3.5 PROJECT CLOSEOUT

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. A total of (4) manuals shall be delivered to Owner. Manuals shall include all service, installation, and programming information.
- B. Provide a full set of "as-built" (redline) drawings in PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-built drawings in 30"x42" size or equivalent, posted in each telecom room involved in the project.

END OF SECTION 27 10 00

SECTION 271323 – COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

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. 62.5/125-micrometer, multimode, optical fiber cable (OM1).
 - 2. 9/125 micrometer single-mode, indoor-outdoor optical fiber cable (OS2).
 - 3. 9/125 micrometer single-mode, outside plant optical fiber cable (OS2).
 - 4. Optical fiber cable connecting hardware, patch panels, and cross-connects.
 - 5. Cabling identification products.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

- A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Cabling administration drawings and printouts.
 - 2. Wiring diagrams to show typical wiring schematics including the following:
 - a. Telecommunications rooms plans.
 - b. Telecommunications pathways.
 - c. Patch panels.
 - d. Patch cords.
 - 3. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
- C. Optical fiber cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Product Certificates: For each type of product.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

- A. Description: Multimode, 62.5/125-micrometer, 6-fiber, nonconductive, tight buffer, optical fiber cable.
- B. Manufacturers:
 - 1. CommScope
 - 2. Mohawk
 - 3. Superior Essex
 - 4. Systimax
 - 5. Substitutions: Under provisions of Division 01.
- C. Standards:
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA-568-C.3 for performance specifications.
 - 3. Comply with TIA-492AAAA for detailed specifications.
- D. Maximum Attenuation: 3.50dB/km at 850 nm; 1.5dB/km at 1300 nm.
- E. Minimum Overfilled Modal Bandwidth-length Product: 200 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- F. Jacket:
 - 1. Jacket Color: Orange.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 48 inches.
- G. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - 1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - 2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
 - 3. Plenum Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit.
 - 4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFNP, or Type OFNR in metallic conduit.
 - 5. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - 6. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.

7. Riser Rated, Nonconductive: Type OFNP or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.3 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

- A. Description: Single mode, 9/125-micrometer, 12 fibers, single loose tube, unarmored optical fiber cable.
- B. Manufacturers:
 1. CommScope
 2. Mohawk
 3. Superior Essex
 4. Systimax
 5. Substitutions: Under provisions of Division 01.
- C. Standards:
 1. Comply with TIA-492CAAB for detailed specifications.
 2. Comply with TIA-568-C.3 for performance specifications.
 3. Comply with ICEA S-104-696 for mechanical properties.
- D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- E. Jacket:
 1. Jacket Color: Yellow.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
 2. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.

2.4 9/125 MICROMETER SINGLE-MODE, OUTSIDE PLANT OPTICAL FIBER CABLE

- A. Description: Single mode, 9/125-micrometer, 12 fibers, single loose tube, optical fiber cable.
- B. Manufacturers:
 1. CommScope
 2. Mohawk
 3. Superior Essex
 4. Systimax
 5. Substitutions: Under provisions of Division 01.
- C. Standards:
 1. Comply with TIA-492CAAB for detailed specifications.
 2. Comply with TIA-568-C.3 for performance specifications.
 3. Comply with ICEA S-87-640 for mechanical properties.
- D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
- E. Jacket:
 1. Jacket Color: Black.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 OPTICAL FIBER CABLE HARDWARE

- A. Standards:
 1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
 2. Comply with TIA-568-C.3.

- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
 - 2. Manufacturer:
 - a. CommScope – 1U Modular Cassette Panel, model 760209940 – HD-1U.
 - b. Engineer approved equal.
 - c. Substitutions: Under provisions of Division 01.
- C. Fiber Adapter Plate: Provide fiber adapter plate(s) within patch panels to accommodate new fiber optic cabling plus 50% spare capacity.
 - 1. Manufacturer:
 - a. CommScope – 12 port cassette, model 760109504 – 360G2 Cartridge 12-LCA-SM-GR-PIGTAILS.
 - b. Engineer approved equal.
 - c. Substitutions: Under provisions of Division 01.
- D. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- E. Connector Type: Type LC complying with TIA-604-10-B connectors.
- F. Plugs and Plug Assemblies:
 - 1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
 - 2. Insertion loss not more than 0.25 dB.
 - 3. Marked to indicate transmission performance.
- G. Jacks and Jack Assemblies:
 - 1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
 - 2. Insertion loss not more than 0.25 dB.
 - 3. Marked to indicate transmission performance.
 - 4. Designed to snap-in to a patch panel or faceplate.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.
- B. General Requirements for Optical Fiber Cabling Installation:
 - 1. Comply with TIA-568-C.1 and TIA-568-C.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 9. In the communications equipment room, provide a 10-foot long service loop on each end of cable.
 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.4 GROUNDING

- A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

- A. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- B. Cable and Wire Identification:
 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Label each unit and field within distribution racks and frames.
 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- C. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
 1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections:
 - 1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.
- F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- G. Remove and replace cabling where test results indicate that it does not comply with specified requirements.
- H. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- I. Prepare test and inspection reports.

END OF SECTION 27 13 23

SECTION 27 51 00 – SOUND REINFORCEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 1 specifications, apply to work specified in this section.
- B. In circumstances where the Specifications and Drawings conflict, the most stringent requirement shall apply. Generally, the Drawings shall govern quantity and the Specifications shall govern quality.
- C. Drawings:
 - 1. Layout: Follow the general layout shown on the Drawings except where other work may conflict with the Drawings.
 - 2. Accuracy: The Drawings show a diagrammatic representation of the system within the constraints of the symbology applied.
 - 3. The Drawings do not necessarily show all raceway, wire and cabling between every system component, equipment, device, etc.

1.2 SUMMARY

- A. Provide fully operational sound reinforcement systems as described herein. The system shall include but not be limited to the following items:
 - 1. Complete sound reinforcement systems including speakers, amplifiers, processors, mixers and other related equipment.
 - 2. Cables and control wiring.
 - 3. Speaker rigging hardware.
 - 4. Equipment racks.
 - 5. Control Equipment.

1.3 SUBMITTALS

- A. Submit required submittals in accordance with Section 013300.
- B. Obtain approval in writing by the Engineer for the Product Data submittals and for the Shop Drawings (as required) prior to release of order for materials and equipment, and prior to installation. Review of A/E does not relieve the Contractor of their responsibilities to furnish and install materials and equipment required for work in the project, nor does such review relieve the Contractor of their responsibilities for the coordination with other trades and designers to ensure that such materials and equipment will fit and be suitable for purpose intended.

1.4 SHOP DRAWINGS

- A. Provide Shop Drawings showing equipment locations and routing of cables and wiring in conduits and raceways where they differ from the project drawings. Shop drawings shall indicate cable types and sizes, routing, connection points, equipment locations, point numbers, and equipment addresses; and other such information.
- B. Shop drawing floor plans shall be prepared using a standard architectural scale. Preferable scale of floor plans for Shop Drawings shall be 1/8" = 1'.
- C. Approved shop drawings shall be used as plan for system installation.
- D. Provide PDF & CAD file drawings for A&E review.

1.5 CONTRACTOR REQUIREMENTS

- A. The System Vender shall be a manufacturer-authorized dealer/distributor for the system equipment manufacturer with the capability of offering factory-certified service at the Project site, both during and after the warranty period.

- B. Technicians qualified for the work. Provide evidence in the bid submission of Technician qualifications. Evidence shall consist of manufacturer training, industry training, relevant project experience, etc.

PART 2 - PRODUCTS

2.1 SOUND SYSTEM MATERIALS

- A. The speaker system shall be a high-level distributed system. The speaker system shall be low impedance and be processed via Digital Signal Processor (DSP) with outputs to allow for individual equalization and control of levels.
- B. The DSP units shall be rack mountable and programmed via external software. The processors shall provide individual inputs and outputs, system equalization and individual speaker sector selection through use of pre-sets.
- C. Speaker System shall provide for even distribution of sound throughout the Grandstands.
 - 1. Loud Speaker:
 - a. System type: Two-way full range
 - b. Weather Resistant IP56
 - c. Frequency Response: 52 – 20,000Hz
 - d. Sensitivity: 98 dB SPL
 - e. Power Handling: 500 watts
 - f. Components: LF 15" High efficiency woofer; HF 1.5" exit, 1" voice coil HF compression driver.
 - g. JBL AWC159 with Mounting Brackets
- D. Amplifiers:
 - 1. 20Hz – 20kHz +/- .25 dB frequency response
 - 2. Damping factor greater than 3,000 from 100 to 3000Hz
 - 3. 1250 watts per channel into 8 ohm at 0.35% THD
 - 4. Auto-standby after 30 minutes
 - 5. Crown DCi 4/1250 power amplifier
- E. Microphone Mixers/Digital Signal Processors
 - 1. Twelve Input, Eight Output DSP with Mic/Line Input Mixing Functions
 - a. Each Input to include leveling, parametric and graphic equalization, high and low pass filters and delay.
 - b. Twelve Balanced inputs and Eight Balanced outputs
 - c. Front panel status LED's
 - d. Programmed from PC with Windows software
 - e. Biamp Tesira Forte Digital Signal Processor. Provide with wall mounted TEC-1i Control Plate. Provide Pakedge MS- 2424 POE switch (QTY 1).
 - 2. Mixer
 - a. 2RU rack mount mixer
 - b. Four High Gain Mic/Line Preamplifiers, two stereo inputs
 - c. Bluetooth Inputs
 - d. Phantom Power
 - e. Aux sends and returns
 - f. Two band EQ per channel
 - g. Alesis Multimix 12R
- F. Sound Equipment Rack
 - 1. Networx WMC-S101-18U fixed rack with locking rear solid door with Full vented locking front door (QTY=1 Press Box)
 - 2. Furman CN-2400S Power Conditioner and Sequencer (Qty 1 each Press Box)
 - 3. Lowell UDE-314 3RU Storage Drawers (QTY=1 each Press Box)
 - 4. Fill all unused rack spaces with blank panels.
- G. Cable/Hardware

1. Jacketed Speaker cable, West Penn 227. 12 AWG UTP
 2. Jacketed Microphone/line cable, West Penn 291, 22AWG TSP
 3. Jacketed Antenna cable, West Penn 813, RG58A/U
 4. Supply all structural support as required for safe and properly oriented speakers.
- H. Microphones
1. Wired, dynamic, stand and extension cable:
 - a. Shure SM58S with on-off switch (QTY=1 each Press Box)
 - b. Conquest S2BN 25, 25 foot microphone extension cable (QTY=2 each Press Box)
 - c. Shure MX412D/C with on-off switch (QTY=1 each Press Box)
 2. Wireless
 - a. Shure QLXD24/SM86 Handheld Wireless microphone system (QTY=2 each Press Box).
 - b. Shure QLXD14/85 Bodypack transmitter Wireless microphone system with WL185 lapel microphone. (QTY=1 each Press Box).
 - c. Shure UA844SWB Active Antenna Splitter (QTY=1 each Press Box)
- I. Compact Disc Player
1. Rack mountable
 2. CD-R/RW playback compatibility, MP3 playback, single disc, integral iPod docking station
 3. Pitch control, +/- 12%
 4. Direct track select buttons
 5. Tascam CD-200BT (QTY=1 each Press Box)
- J. Hearing Impaired System (ADA)
1. FM Frequency Agile Transmitter and Receiver System
 2. Transmitter with inputs to accept microphone, line or speaker level signals
 3. Receiver is body worn with ear speaker and battery
 4. System to be tunable to 38 narrow band channels
 5. Typical range shall be 1,000 foot radius unobstructed with dipole antenna.
 6. Listen LS-54-072 System with four (4) total receivers, four (4) pairs of LA-361 alkaline double AA batteries, four (4) LA-164 ear speakers, two (2) LA-166 neck loops, LA-124 remote antenna and LA-326 Rack Kit (QTY= 1 each Pressbox)

PART 3 - EXECUTION

3.1 GENERAL

- A. All equipment and enclosures described in this specification shall be installed plumb and square per manufacturer's instructions.
- B. All equipment, except that designated as movable, portable or loose equipment, shall be secured and permanently attached to the permanent structure in a manner which will require the use of a tool (e.g. screwdriver, nut driver, etc.) for removal.
- C. Test all portable components prior to delivering to owner. Provide transmittal for owner's signature and deliver to location directed by owner.

3.2 INSTALLATION

- A. The System shall be installed and tested in accordance with the Manufacturer's Installation instructions. The following conditions are applicable:
 1. All necessary back-boxes, pull-boxes, connectors, supports, conduit, cable, and wire shall be furnished and installed to provide a complete and reliable System installation.

2. All conduit, cable, and wire shall be installed parallel and square with building lines, including raised floor areas. Conduit fill shall not exceed forty percent (40%). All wires shall be gathered and tied up to create an orderly installation.
3. Install the paging system in accordance with the manufacturer's recommendations. Locate equipment and devices as indicated on the drawings.
4. Installation of equipment and devices shall be coordinated with architectural features and the installation of door hardware equipment.
5. Select cabinets and back-boxes to fit equipment and devices. Install plumb and aligned with building elements.
6. Outside electrical rooms and telecommunications rooms, wiring and cable shall be installed in raceways, except low-voltage cables run above accessible ceilings consisting of removable tiles. Raceways shall be grounded to the power system ground.
7. Cables shall extend from the control cabinet to the device locations and between devices in uninterrupted continuous runs, without intermediate splices. Cables shall be free from shorts or grounds.
8. Cables shall be routed so as to maintain a separation of at least 24" from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Avoid exposed cables in occupied areas or in areas where they might be damaged as a result of normal use of the area. Where two (2) or more cables run in parallel, they shall be bundled with cable ties.
9. Cables run exposed in accessible ceiling cavities shall be supported by means of suitable cable support devices from the building structure. They shall not lie upon the ceiling, nor shall they be supported from the ceiling frame, ceiling suspension wires, conduits, pipes, ductwork or lights. Supports shall be spaced no further apart than five feet on center.
10. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced. Type and spacing of supports shall ensure that cable will not kink or sag.
11. Cable shall be neatly dressed in the equipment rooms, without excessive slack. Cable path shall offer minimum obstruction to future installation. Avoid cables crossing horizontally through the areas just above or below riser sleeve or cable tray penetrations.
12. In each cable that terminates at a device, provide 12" of slack cable, neatly coiled, to facilitate future modifications.
13. Terminations shall be made in a neat and workmanlike manner.
14. All terminations, controls and outlets shall be clearly and logically labeled in accordance with the requirements in Section 260533.
15. No power shall be applied to the equipment until all connections between the equipment and the wiring system have been checked for grounds, shorts, opens or other wiring defects, and approved by a representative of the equipment manufacturer.

3.3 RACEWAY

- A. Provide metallic raceways for cables installed in wall cavities, above inaccessible ceilings, locations without ceilings or other exposed locations.
- B. The Contractor shall provide a complete design-build raceway and cabling system.

3.4 PROTECTION AND CLEANING

- A. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

- B. Repair or replace damaged components before Substantial Completion of the project.
- C. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of the equipment. Remove construction debris from equipment area and dispose of properly.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's staff to adjust, operate, and maintain equipment.
- B. Upon completion and testing of the system, the contractor shall provide a minimum of one (8) hour, on-site, instructor-led end-user training session for school district administration and IT staff to demonstrate and instruct staff on features, functions, operation and maintenance.

3.6 TESTING

- A. Verify the following before beginning actual tests and adjustments on the system:
 - 1. Electronic devices are properly grounded.
 - 2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
 - 3. Insulation and shrink tubing are present where required.
 - 4. Dust, debris, solder splatter, etc. is removed.
 - 5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
- B. Preparation for Acceptance, prior to final inspection:
 - 1. Temporary facilities and utilities shall be properly disconnected, removed and disposed of off-site.
 - 2. All systems, equipment and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
 - 3. All materials shall be neat, clean and unmarred and parts securely attached.
 - 4. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. shall be replaced or properly repaired, and debris cleaned up and discarded.
 - 5. All extra materials, portable equipment, and spares shall be delivered and stored at the premises as directed.
 - 6. Audio System Tests. Perform the following tests and adjustments, supplying test equipment required. Follow EIA Standards RS-160 and RS-219 in performing tests. Make corrections necessary to bring system(s) into compliance with the specifications.
 - 7. Measure and record the impedance of each loudspeaker / speaker line circuit terminating at the equipment rack. Use 100 Hz for low frequency speakers, 1k Hz for mid-range speakers, 4kHz for high frequency horns. For full range devices, use 1k Hz.
 - 8. Check polarity of loudspeakers with an electronic polarity checker and by applying music program or constant power per octave (pink noise) signal to system while walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next.
 - 9. Apply sine wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5k Hz and at a level 10dB below full amplifier output, and listen for rattles or noise. Correct if apparent.

END OF SECTION 27 51 00

DIVISION 28– FIRE ALARM AND SECURITY

Section 28 05 13	Conductors and Cables for Electronic Safety and Security	8
Section 28 08 00	Electronic Safety and Security Commissioning	2
Section 28 31 13	Intrusion Security System	12
Section 28 46 21	Addressable Fire Alarm System	8

DIVISION 29 through DIVISION 30 – not used

SECTION 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balanced twisted-pair cabling.
 - 2. RS-232 cabling.
 - 3. RS-485 cabling.
 - 4. Control-voltage cabling.
 - 5. Control-circuit conductors.
 - 6. Fire alarm wire and cable.
 - 7. Identification products.

1.2 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Cabling administration drawings and printouts.
 - 2. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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.

2.2 CATEGORY 5e BALANCED TWISTED-PAIR CABLE

- A. Description: Four-pair, balanced twisted-pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables and NFPA 70 for the following types:
 - 1. Communications, Non-plenum: Type CMR complying with UL 1666.

- C. Conductors: 100-ohm, 24 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Jacket: White thermoplastic.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced twisted-pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables and NFPA 70 for the following types:
 - 1. Communications, Non-plenum: Type CMR complying with UL 1666.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Cable Rating: Riser.
- F. Jacket: Blue thermoplastic.

2.4 BALANCED TWISTED-PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- D. Connecting Blocks:
 - 1. 110-style IDC for Category 5e.
 - 2. 110-style IDC for Category 6.
 - 3. 110-style IDC for Category 6a.
 - 4. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair cable indicated.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

- H. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568-C.2.
 - 3. Marked to indicate transmission performance.
- I. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or faceplate.
 - 3. Standard: Comply with TIA-568-C.2.
 - 4. Marked to indicate transmission performance.
- J. Faceplate:
 - 1. Two port, vertical single gang faceplates designed to mount to single gang wall boxes.
 - 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
 - 3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
 - 4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- K. Legend:
 - 1. Machine printed, in the field, using adhesive-tape label.
 - 2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 RS-485 CABLE

- A. PVC-Jacketed, TIA 485-A Cables:
 - 1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. NFPA 70 Type: Type CM.
 - 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. NFPA 70 Type: Type CMP
 - 6. Flame Resistance: NFPA 262, Flame Test.

2.6 CONTROL-VOLTAGE CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.

4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.7 FIRE ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG or size as recommended by system manufacturer.
 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test balanced twisted-pair and optical-fiber cables on reels according to TIA-568-C.1.
- C. Factory test balanced twisted-pair cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for installation of supports for cables.

3.2 WIRING METHOD

- A. Install wiring in metal pathways and wireways.
 1. Minimum conduit size shall be 3/4 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.
 2. Comply with requirements in Section 270528 "Pathways for Communication Systems."
- B. Install cable, concealed in accessible ceilings, walls, and floors when possible.
- C. Wiring on Racks and within Enclosures:
 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination

Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.

2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
- D. Install balanced twisted-pair cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- E. General Requirements for Cabling:
 1. Comply with TIA-568-C.1.
 2. Comply with BICSI "Information Technology Systems Installation Methods Manual."
 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Leave a minimum of 6 inches of slack at outlet terminations and coil loosely into box after termination on outlet fitting.
 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 5. Maintain minimum cable bending radius during installation and termination of cables.
 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 8. Pulling Cable: Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
 9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.
- F. Balanced Twisted-Pair Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
 1. Comply with TIA-568-C.2.
 2. Install 110-style IDC termination hardware unless otherwise indicated.

3. Do not untwist balanced twisted-pair cables more than 1/2 inch from point of termination to maintain cable geometry.
- G. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 260528 "Pathways for Communications Systems".
 3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.
- H. Separation from EMI Sources:
1. Comply with BICSI Telecommunications Distribution Methods Manual and TIA-569-D recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches.
 6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528 "Pathways for Communications Systems."
 - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 - 1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
 - 3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, "Firestopping" Annex.

- C. Comply with BICSI Telecommunications Distribution Methods Manual Telecommunications Distribution Methods Manual, "Firestopping Systems" Article.

3.7 GROUNDING

- A. For communication wiring, comply with TIA-607-B and with BICSI Telecommunications Distribution Methods Manual 's "Bonding and Grounding (Earthing)" chapter.

3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Visually inspect balanced twisted-pair and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test balanced twisted-pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI Telecommunications Distribution Methods Manual as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 28 05 13

SECTION 28 08 00 ELECTRONIC SAFETY AND SECURITY COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

- A. The purpose of this section is to describe the commissioning process specific for those sections listed in Division 28.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. General Responsibilities: The Contractor's commissioning responsibilities applicable to each of the Contractors for Fire Alarm and Security are as follows:
 - 1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - 2. Attend a commissioning kick-off meeting and other meetings necessary to facilitate the Commissioning process.
 - 3. Contractors shall assist in clarifying the installation, operation, maintenance, and control of commissioned equipment if requested by the Commissioning Authority.
- B. Coordination
Refer to Section 019113 for a listing of all sections where commissioning requirements are found, for systems to be commissioned and for Pre-verification testing requirements.

1.3 SUBMITTALS

- A. General Submittals: Contractor shall provide to the Commissioning Authority, through established channels, normal cut sheets and shop drawing submittals, and manufacturer's installation, start-up, and testing checklists, for all commissioned equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation Checklists: The Contractor shall complete the checklist(s) provided with and using the Facility Grid app.
 - 1. The completion of these checklists does not limit the Contractor's responsibilities for quality control and scheduling as indicated elsewhere in the documents, nor does this checklist include all submittal, inspection, or quality assurance requirements for the work of this Section.

3.2 CLOSEOUT ACTIVITIES

- A. Functional Performance Testing: The Contractor shall complete the tests indicated in this Section with the consultant/AHJ present.
 - 1. Security System: Testing of the Security System will be performed with the A/E consultant present.
 - 2. Fire Alarm System: Testing of the Fire alarm system will be done prior to training and with the Fire Marshall and A/E consultant present.
 - 3. Training: The Owner personnel shall be trained on procedures related to section 1.1A above.

3.3 DOCUMENTS REQUIRED

- A. The General Contractor will provide the following documentation before Final Acceptance:
 - 1. Completed Inspection Forms with approval signatures of all Authority Having Jurisdiction.

2. Approval Signature of A/E Consultant
3. Copies of Completed Manufacturer Functional Tests

END OF SECTION 28 08 00

SECTION 28 31 13 - INTRUSION SECURITY SYSTEM

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to work specified in this section.
- B. Refer to Division 27, Section 271000, "Structured Cabling". Comply with all requirements of this section.
- C. Related sections:
 - 1. Section 260533: Raceway & Boxes
 - 2. Section 260529: Hangers & Supports
 - 3. Section 260533: Identification for Electrical Systems

1.2 SUMMARY

- A. Provide in operating condition an electrically operated intrusion detection system as described herein. The system shall include, but not be limited to, control panel, power supplies, proximity card readers, cards, keypads, detection devices, programming, conduit, wire, fittings and other relevant components and accessories required to provide a complete operating security system. All units shall be located in accordance with the plans. The intrusion detection system shall utilize applications based upon the Bosch and Genetec platform.
- B. Provide a complete intrusion detection system with a digital communicator for digital transmission to a Remote Reporting Agency.
- C. Program the intrusion detection systems in accordance with directions received from the Owner's Representative.
- D. Adjust and test the intrusion detection systems, and demonstrate the system to the Owner's Representative.
- E. Instruct the Owner's staff in operating the systems and recommended maintenance procedures.

1.3 REFERENCES

- A. Underwriters Laboratories (UL):
 - 1. UL 609 – Local Burglar Alarm Units and Systems
 - 2. UL 1635 – Digital Burglar Alarm Communicator System Units
- B. Federal Communications Commission (FCC):
 - 1. Code of Federal Regulations Title 47 - Part 15 – Radio Frequency Devices.
 - 2. Code of Federal Regulations Title 47 - Part 68 – Connection of Terminal Equipment to the Telephone Network.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA70 – National Electrical Code.

1.4 SYSTEMS DESCRIPTION

- A. The security intrusion alarm system shall consist of an integrated alarm processor, digital communicator, keypads, and shall support the connection, monitoring and reporting of intrusion devices.
- B. The system shall include an automatic dialer to report alarms over dial-up telephone lines to the Owner's monitoring vender. Provide dialer programming hardware, software and services. Program dialer as requested by the Owner and their monitoring vendor.
- C. System shall be capable of monitoring no less than 574 custom points of security.
- D. The system shall communicate alarm conditions at both the individual point and

zone level.

- E. The system shall provide the following relay output control and operational functions:
 - 1. Each security system output point (door lock, gate controller and other associated relay outputs) shall have a user-specified 16 character, minimum, test identifier. Each point shall be software programmable for activation and deactivation, and shall be capable of reporting short circuit trouble, open circuit trouble, ground fault trouble and circuit fault trouble.

1.5 QUALIFICATIONS OF SYSTEM VENDER

- A. The System Vender shall be a manufacturer-authorized dealer/distributor for the intrusion detection system equipment manufacturer with the capability of offering factory-certified service at the Project site, both during and after the warranty period.
- B. The System Vendor shall employ trained technicians skilled in maintenance of intrusion detection systems and shall maintain a service organization with spare parts in stock within 50 miles of the Project site. The technicians shall be licensed as required by local and State jurisdiction to perform work on limited-energy systems. The service organization shall have the equivalent of 5 years experience in servicing intrusion detection systems, and shall be capable of responding to service calls within 24 hours. Furnish references upon request.

1.6 QUALIFICATIONS OF SYSTEM INSTALLER

- A. The System Installer shall be an organization specializing in installation of low-voltage systems and having the equivalent of 5 years experience in installing intrusion detection systems similar in scope and complexity to the system required for this Project. The organization shall employ factory-trained technicians skilled in installation of intrusion detection systems, who have been trained by the intrusion detection system manufacturer in the installation of the equipment provided on this project. The technicians shall be licensed as required by the local and State jurisdictions to perform work on limited-energy systems, and shall have successfully installed at least two (2) other intrusion detection system of the same type, size, complexity and manufacturer as that provided for this Project. The previously installed system shall have been in operation for at least 12 months. Furnish references upon request.

1.7 SUBMITTALS

- A. Product Data:
 - 1. Submit for each type of product indicated.
- B. Shop Drawings:
 - 1. Indicate on shop drawings the locations of each magnetic contact, motion sensor, keypads and all other intrusion system devices.
 - 2. Indicate on shop drawings all interconnecting wiring between control equipment and peripheral devices for both systems, including wire routing, wire type and manufacturer catalog number, and wire size and conductors.
- C. Submittals shall include manufacturer data sheets for all major system components.

1.8 INFORMATION FOR OPERATING & MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Operating Instructions: Supply a detailed narrative description of the system operation. Indicate expansion capability, application conditions and limitations of use. Include manufacturer's installation and operating instructions.

- C. Maintenance Instructions: List replacement parts, including source. Indicate recommended maintenance and testing procedures, and the intervals involved for each. List all individual system components that require periodic maintenance. Detail trouble-shooting procedures. Include a service directory with names and telephone numbers for use in obtaining service.
- D. Program Record: Provide record sheets listing the panel programming selections implemented.
- E. Warranty: Manufacturer's or Vendor's warranty certificate.

1.9 SYSTEM OPERATION

- A. The system shall be programmable locally or remotely. Programming shall be accomplished via a portable programmer or a computer running the software.
- B. To access the building when the security intrusion system is armed and the building is locked a user will do the following:
 - 1. Place a valid card in range of the proximity reader, which shall release the electric door latch mechanism.
 - 2. Enter the building and disarm the security system by pressing the proper code sequence into the keypad.
 - 3. If a card is presented to the reader during a time or date that is not within its programmed privileges, the door shall not be unlocked.
 - 4. If a lost/stolen card is presented at the reader, access shall be denied, an alarm shall be transmitted to the local control panel, and an alarm shall further be transmitted to the monitoring station. The event shall be recorded on the local printer. The security system shall not be placed into alarm unless there is an unauthorized entry or other valid alarm condition.
- C. Upon actuation of any automatic detection device, breaking of any magnetic contact, or a keypad initiated alarm, all alarm functions shall operate in appropriate fashion.
 - 1. The following additional functions shall be performed in the event of an alarm, as shown:
 - a. Security alarms shall activate the remote signaling circuit of the security intrusion panel, which shall dial a coded alarm message to the remote monitoring station. If the first voice line is not usable, a second voice line shall be utilized.
 - b. Shutdown of the system shall be accomplished at the local control panel by authorized personnel.
- D. The arming procedure shall be as follows:
 - 1. Entering the arming code on the keypad shall cause the system to be selectively armed.
 - 2. System shall give visual and audible indication if it is armed while a non-auto-shunted zone is in trouble status. A low battery condition shall give an audible alarm upon arming.
 - 3. System shall dial the monitoring station number to give a closing system status report and shall give visual or audible indication of the monitoring station verification signal (ring back).
 - 4. After system has been successfully armed and ring back has been received, the exit delay period (user programmable up to 4 minutes) shall begin (if the delay has not been canceled by the operator), allowing the operator to exit the building without causing an alarm.
- E. The disarming procedure shall be as follows: Entering the disarming code on the keypad shall cause the zones to be disarmed. The other zones shall remain operational.
 - 1. Alarm reports shall be classified into sub-categories as follows:
 - a. Opening and closing reports
 - b. Service Log

- c. Test / Status Reports
- d. Diagnostic
- e. Relays
- f. Power / Phone Supervision
- g. Remote programming attempts

PART 2 - PRODUCTS

2.1 INTRUSION SYSTEM

- A. Manufacturer: Bosch.
- B. Control Panel: B9512G with E-Net.
- C. Enclosure: B8103
- D. At a minimum, the control panel shall provide the following:
 - 1. The control panel shall be capable of providing identification, annunciation, and communication of up to 142 identifiable points; of which 32 are on-board loops and the balance are off-board addressable points or zones.
 - 2. Provide addressable expansion modules, model as required to provide identification for addressable devices shown on Construction Drawings.
 - 3. Expansion to a total of at least 10,000 different user codes with 99 user profile definitions
 - 4. 12,000 event log capability indicating time, date, type of event, location and user ID
 - 5. Sixteen (16) independent door/keypad addresses, each with four zones
 - 6. Twenty (20) holiday dates for custom holiday scheduling by area
 - 7. Four (4) shift schedules per area
 - 8. A total of at least 100 programmable output relay schedules
 - 9. Thirty-two (32) individual reporting areas
 - 10. The control panel shall be equipped with a phone line monitor and shall interface with the phone lines via RJ-31X jacks for supervision of the telephone line connection. When a telephone line is determined to be out of service by the control panel, the event will be annunciated locally and transmitted to the monitoring station. A telephone line switching module shall be used to interface to a second telephone line. This interface shall conform to FCC rules part 15 and 68.
 - 11. Built-in bell and telephone line supervision
 - 12. Four to Six-digit user passcodes
 - 13. Anti-pass back access control selectable by area and user
 - 14. Local and remote diagnostics
 - 15. Require two-man access code or credentials.
 - 16. Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.
 - 17. Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.
 - 18. Ability to create zones within the building to disarm/arm each zone independently.
- E. The control panel shall be configured, but not limited to the following devices to form a complete and operational system.
 - 1. HID connection Devices
 - 2. Interface modules (counts based upon end devices)
 - 3. 12V and 24V power supplies
 - 4. Enclosure shall be 14.5"W x 32"H x 4"D and gray in color
- F. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.

- G. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.
- H. Control unit must be 'Flash ROM' updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
- I. Serial Interface: The control panel shall be capable of a serial interface to output information to a standard serial printer or serial interface to a communication port on a standard computer. Through control panel programming the system shall include a provision to allow the selection of which reports are to be output.
- J. Power Supplies:
 - 1. Power supplies for the control unit shall operate from a dedicated 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all solid state.
 - 2. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switchover; a signal shall be initiated upon failure of battery or alternating current power.
 - 3. Approved power supplies shall meet or exceed the following power supply model specifications:
- K. Secondary Power (standby battery):
 - 1. Provide adequate battery power for the intrusion detection system as defined by the application criteria, UL 985 and 865 for alarm installations. Provide battery charger consistent with the battery back-up capacity. Provide standby battery power to support 24 hours of continuous operation in case of 120VAC power failure. In addition, the standby power shall support 5 minutes of alarm operation at the end of the 24-hour period.
 - 2. Secondary power supervision: When the secondary power source experiences an 85% depletion of its standby capacity, the system shall report a "Low Battery" message to the monitoring station. The system shall always display a low battery condition.
- L. All intrusion detection system power supplies, other than those utilized for electronic door latch/strike hardware shall be located in the MC/HC rooms.
- M. Software:
 - 1. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:
 - a. Direct cable connection interface card
 - b. Receiver phone line connection
 - c. Standard phone line connection
 - d. Ethernet network connection
 - e. Network connection across the internet
 - 2. The system shall interface with computer software capable of monitoring and logging all events.
 - 3. The system shall interface with computer software capable of exporting reports in the following file formats:
 - a. Excel Spreadsheet (*.xls)
 - b. Rich Text (*.rtf)
 - c. Windows Metafile (*.wmf)
 - d. Text (*.txt)
 - e. Comma-separated (*.csv)
 - f. HTML document (*.htm)
 - 4. The system shall interface with computer software capable of printing custom, filtered reports including:

- a. All Events
 - b. Zone Action
 - c. Arming/Disarming
 - d. Area Late to Close
 - e. User Code Changes
 - f. Opening/Closing Schedule Changes
 - g. System Monitors
 - h. System Events
- N. Functional Descriptions:
 - 1. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
 - 2. The system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors or door position switches.
 - 3. The system shall support user interaction by way of a keypad, web browser or system software, using integrated or auxiliary devices provided by the system manufacturer.
 - 4. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hardwire and/or wireless zone expansion equipment for at least 200 wireless zones and/or a maximum of 574 hardwired zones.
 - 5. The system shall be capable of offering at least five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable.
 - 6. The system shall provide a seamless capability to provide a minimum of 100 addressable relays, which can be located at any connection location upon a zone expansion bus.
 - 7. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
 - 8. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
 - 9. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, and/or by way of the internet.
 - 10. The control unit shall be completely programmable remotely using annunciators, personal computer, and/or using upload/download software that communicates using SDLC 300 baud, 2400 baud, or IP addressed at a network.
 - 11. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.
- O. Input/Output Capacity:
 - 1. This system shall be capable of monitoring a maximum of 142 individual zones and controlling a maximum of 100 output relays.
 - 2. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 502 auxiliary relays (Form C rated at 1.0 amp at 30 VDC).
 - 3. The panel shall also provide 100 programmable output schedules, and include an integral bell alarm circuit providing at least 1.5 amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn

on and/or off at selected times each day.

- P. User/Authorization Level Capacity: The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

2.2 ELECTRONIC COMPONENTS

- A. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
- B. The panel shall have an overcurrent notification LED that lights when devices connected to the keypad bus and LX-bus(es) draw more current than the panel is rated for. When the overcurrent LED lights, the LX-bus(es) and keypad bus are shut down.

2.3 ENCLOSURE

- A. Housings: Power supply enclosure, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three- point latching device with lock; or alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tamperers UL listed for use with the XR100/XR100N shall be used.

2.4 PERIPHERAL DEVICES

- A. Keypad: The keypads shall be capable of the following:
 - 1. Trouble/supervisory alarm.
 - 2. Performing all system arming/disarming functions via passcode entry.
 - 3. Perform all system arming/disarming functions via internal proximity reader.
 - 4. Being assigned to any partition.
 - 5. 32 character display.
 - 6. Backlit keys for visibility.
 - 7. Real time clock display.
 - 8. Alarm history.
 - 9. Alarm by assign point.
 - 10. Zones and system events displayed in plain English.
 - 11. Functions performed by entering security code plus command.
 - 12. Built-in speaker.
- B. Door Contact Switches, Magnetic Type: Contacts shall be designed for flush mounting in steel door frames. Contacts shall be 3/4" diameter for steel door frames. Contacts shall be rated for a gap of not less than 1/2". Each contact shall be hermetically sealed for long term operation and rated for 10,000,000 operating cycles. Switch contacts shall use screw terminal wire connections. Switch contacts shall be of the reed blade type with rhodium plating eliminating cold-welding; sticking and resistance build-up. Magnetic door contact switches shall be equivalent to: ISN-CSD70-W.
- C. Roll-up Door Position Switches: Overhead door witch with magnet with no dead spot.
- D. Glass Break Detectors: Provide DS1108i detector.
- E. Motion Detectors: Passive infrared type. Utilize MX938I to provide optimal coverage in spaces indicated.

2.5 CABLING

- A. Provide UL listed power limited cables under NEC 725 Class II wiring where required.
- B. Minimum 18 AWG solid copper conductors for power connectivity.
- C. Twisted pair cable shall be used to prevent EMI/RFI interference with the proper operation of the security circuits.
- D. Cabling shall be UL910, NFPA 262, CMP (plenum), rated unless otherwise noted.
 - 1. Manufacturer is Belden or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Submission of a proposal confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted.
- B. The site shall be visited on a regular basis to appraise ongoing progress of other trades and contracts, make allowances for all ongoing work, and coordinate the requirements of this contract in a timely manner.

3.2 INSTALLATION

- A. The System shall be installed and tested in accordance with the Manufacturer's Installation instructions. The following conditions are applicable:
 - 1. All necessary back-boxes, pull-boxes, connectors, supports, conduit, cable, and wire shall be furnished and installed to provide a complete and reliable System installation.
 - 2. All conduit, cable, and wire shall be installed parallel and square with building lines, including raised floor areas. Conduit fill shall not exceed forty percent (40%). All wires shall be gathered and tied up to create an orderly installation.
 - 3. Install the security intrusion detection system in accordance with the manufacturer's recommendations. Locate equipment and devices as indicated on the drawings.
 - 4. Installation of equipment and devices shall be coordinated with architectural features and the installation of door hardware equipment.
 - 5. Final connections between the equipment and the wiring system shall be made under the supervision of a representative of the system vendor/installer.
 - 6. Select cabinets and back-boxes to fit equipment and devices. Install plumb and aligned with building elements.
 - 7. Outside electrical rooms and telecommunications rooms, wiring and cable shall be installed in raceways, except low-voltage cables run above accessible ceilings consisting of removable tiles. Raceways shall be grounded to the power system ground.
 - 8. Cables shall extend from the control cabinet to the device locations and between devices in uninterrupted continuous runs, without intermediate splices. Cables shall be free from shorts or grounds.
 - 9. Cables shall be routed so as to maintain a separation of at least 24" from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Avoid exposed cables in occupied areas or in areas where they might be damaged as a result of normal use of the area. Where two (2) or more cables run in parallel, they shall be bundled with cable ties.
 - 10. Cables run exposed in accessible ceiling cavities shall be supported by means of suitable cable support devices from the building structure. They shall not lie upon the ceiling, nor shall they be supported from the ceiling frame, ceiling suspension wires, conduits, pipes, ductwork or lights. Supports shall be spaced no further apart than five feet on center.
 - 11. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced. Type and spacing of supports

- shall ensure that cable will not kink or sag.
12. Cable shall be neatly dressed in the equipment rooms, without excessive slack. Cable path shall offer minimum obstruction to future installation. Avoid cables crossing horizontally through the areas just above or below riser sleeve or cable tray penetrations.
 13. In each cable that terminates at an outlet or device, provide 12" of slack cable, neatly coiled, to facilitate future modifications.
 14. Terminations shall be made in a neat and workmanlike manner.
 15. All terminations, controls and outlets shall be clearly and logically labeled in accordance with the requirements in Section 260533.
 16. Personnel Door magnetic contacts shall be flush mounted in doors and door frames.
 17. Keypads shall be surface mounted over flush mounted outlet boxes.
 18. Mount the Intrusion control panel/digital communicator in the location indicated and connect it via a telephone line to a Remote Reporting Agency for security system reporting in accordance with the Owner's direction. The security intrusion detection system shall be connected to transmit alarm and trouble conditions by device and zone with the alarm signals having priority over other signals. The communicator output shall match the Remote Reporting Agency protocol and the available telephone dialing scheme.
 19. Provide RJ31X jacks and wiring to interface the control panel to telephone lines for remote reporting. The RJ31X jacks shall be wired into the phone lines so that the control panel is the first device on the phone line, and off-normal panel conditions disconnect all downstream devices sharing the phone line. Program the control panel communicator using the communication protocol compatible with the UL-listed monitoring agent designated by the Owner.
 20. Complete the connection to the monitoring account for the Owner. The control panel/digital communicator provided under this Contract shall remain the property of the Owner.
 21. No power shall be applied to the intrusion detection equipment until all connections between the equipment and the wiring system have been checked for grounds, shorts, opens or other wiring defects, and approved by a representative of the equipment manufacturer.
 22. Comply with all requirements of Section 271000 "Structured Cabling".
 23. Provide one Category 6 patch panel in each IDF and MDF, or as required for the equipment network connections.
 24. Terminate all Category 6 cables for the system.
 25. Coordinate security zone configuration and access levels with owner.
- 3.3 RACEWAY
- A. Provide metallic raceways for cables installed in wall cavities, above inaccessible ceilings, locations without ceilings or other exposed locations.
 - B. The Contractor shall provide a complete design-build raceway and cabling system.
 - C. Any cable underground or under slab in raceway, shall be rated for wet location.
- 3.4 DEVICE BOXES
- A. Provide appropriate back box, as suggested by manufacturer, at each card reader location.
 - B. Provide the manufacturer back box for the door controller.
- 3.5 PROGRAMMING
- A. The intrusion detection system shall be programmed by an authorized manufacturer's representative to function as specified under the description of system operation, including the interface to the digital communicator and zone assignments. Programming shall comply with direction received from the Owner's Representative or Architect.
 - B. Divide the system into the areas indicated on the shop drawings. Program each keypad to activate and deactivate each area by entering separate entry codes. Use codes provided by

- the Owner. Each keypad shall be capable of activating/deactivating each area individually and activating/deactivating all areas simultaneously.
- C. Final system programming shall reflect room numbers/names as selected by the Owner or Architect. Room numbers shown on plans are architectural designs numbers for construction purposes. These numbers shall not be used for programming unless specifically directed by the Owner or Architect.
- D. Coordinate all programming times with owner staff.
- E. Program digital communicator to communicate with the remote reporting agency.
- F. Submit documentation of system programming.

3.6 ADJUSTMENT, TESTING & DEMONSTRATION

- A. Supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment, testing and demonstration.
- B. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating and Maintenance Manuals.
- C. Test all system cable after installation and prior to connection to equipment. Tests to be performed shall include, but not be limited to, the following:
 - 1. Conductor continuity.
 - 2. D.C. insulation resistance.
 - 3. Freedom from shorts and grounds.
- D. Make adjustments as necessary to aim motion sensors and set sensitivity levels to provide proper area coverage in accordance with the direction of the Owner's Representative.
- E. Test all system features for proper function. Tests shall be conducted by the manufacturer's authorized vendor/installer. Notify the Remote Reporting Agency prior to beginning tests. Tests to be performed shall include, but not be limited to, the following:
 - 1. Verify that the keypad functions properly to arm and disarm the system.
 - 2. Verify that the keypad functions properly to acknowledge/deactivate alarms and reset the system.
 - 3. Verify proper operation of battery backup by performing tests for 60 minutes with the normal AC power source disconnected.
 - 4. Verify the proper initiation of the trouble signal for disconnection of AC power.
 - 5. Verify the proper operation and range of coverage for each motion detector by entering the protected space from different directions with the system armed.
 - 6. Verify the proper operation of each door position switch by opening the door with the system armed.
 - 7. Verify the proper annunciation and display of each alarm and trouble condition.
 - 8. Furnish documentation that all alarm and trouble conditions were correctly reported to the Remote Reporting Agency.
- F. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections, with no additional compensation.
- G. After the system has been completed, tested and is operating properly, the manufacturer's representative shall test and demonstrate by actual usage, the proper operation of each control device and system function in the presence of the Owner's Representative. Demonstration shall include repetition of selected field tests, as well as additional adjustment or testing required to demonstrate that the system performs in accordance with the operational description as specified herein and the Owner's operational requirements.

3.7 COMMISSIONING

- 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. 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. Visual Inspection: Conduct visual inspection prior to testing.
2. Inspection shall be based on completed Record Drawings and system documentation.
3. Factory-authorized representative shall demonstrate the system operation and performance to the Commissioning Agent, or other designated agent.
4. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

3.8 DEMONSTRATION

- A. Engage a factory-authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain the ACS system.

3.9 ON-SITE TRAINING

- A. Supply one (8) hour minimum of training for the Owner's staff in operating the intrusion detection systems. In addition, the Contractor shall supply one (4) hour minimum of further training for the Owner's maintenance personnel regarding maintenance of the system. Training time shall be extended as necessary to satisfy the Owner's Representative that all pertinent topics have been adequately covered.
- B. The training shall be conducted after the Operating and Maintenance Manuals for the Project are completed and available for use during the training session.
- C. Maintain a training sign-in sheet upon which participants in the training session, including the instructions, shall record their names. The training sign-in sheet shall be dated.
- D. Training shall be conducted by the manufacturer's authorized vendor/installer of the equipment manufacturer who is thoroughly familiar with the equipment and its features, and with the Project. The training shall include instruction, field demonstration and over-the-shoulder hands-on training. As a minimum, the training shall cover, but not be limited to, the following topics:
- E. General overview of intrusion detection systems, including purpose and principle of operation.
1. System features, including expansion capability.
 2. Interpretation of system outputs (indicators, displays, etc.).
 3. Arming and disarming the system.
 4. Acknowledging/deactivating alarms and resetting the system.
 5. Recommended maintenance procedures and intervals.
- F. At the conclusion of the training session, insert a copy of the training sign-in sheet into the Operating and Maintenance Manuals. Submit another copy of the training sign-in sheet to the Architect.

3.10 AS-BUILT DRAWINGS

- A. The contractor shall certify completion of the intrusion systems installation and testing in accordance with the plans and specifications. Any original copy of the Record of Completion shall be delivered to the Owner's Representative and photocopies shall be included in the O&M manuals.

3.11 OPERATING DOCUMENTS

- A. The contractor shall furnish to the Owner, operating instructions outlining the step-by-step procedures required for system start-up, operation, and shutdown at least thirty (30) calendar days prior to acceptance test. The instructions shall include the manufacturer's name, system model number, service manual, parts list, and a description of all equipment and their basic operating features.

3.12 WARRANTY

- A. The warranty period shall be as specified in the General Conditions, but not less than one (1) calendar year from the date of project final completion. The intrusion detection system equipment vendor shall warranty the all intrusion detection system equipment to be free from defects in materials and workmanship. The installing Contractor shall warranty all wiring and installation devices to be free from defects in materials and workmanship. The warranty shall cover the full cost of all repairs and all replacement costs for all system components. The equipment vendor and installing contractor shall have the option to repair or replace any system component. This warranty shall not be pro-rated, and there shall be no deductible amount.

END OF SECTION 28 31 13

SECTION 28 46 21 - ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.

1.2 ACTION SUBMITTALS

- A. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level III minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product, including furnished options and accessories.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, details, and attachments to other work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Detail assembly and support requirements.
 - 5. Include voltage drop calculations for notification-appliance circuits.
 - 6. Include battery-size calculations.
 - 7. Include input/output matrix.
 - 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 - 9. Include performance parameters and installation details for each detector.
 - 10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.

- b. Show field wiring required for HVAC unit shutdown on alarm.
- c. Locate detectors according to manufacturer's written recommendations.
- D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
 - 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 - 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment.
 - d. Riser diagram.
 - e. Record copy of site-specific software.
 - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - g. Manufacturer's required maintenance related to system warranty requirements.
 - h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and speaker/strobe evacuation.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 8. Recall elevators to primary or alternate recall floors.
 - 9. Activate emergency shutoffs for gas and fuel supplies.
 - 10. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.

2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in internal circuits of fire-alarm control unit.
 6. Abnormal ac voltage at fire-alarm control unit.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at fire-alarm control unit.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
 2. Identify specific device initiating the event at fire-alarm control unit.
 3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
1. Gamewell E3 Series.
 2. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 3. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 4. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
 5. Voice notification unit shall be capable of sending messages in both English and Spanish.
- B. Wireless Fire Alarm Monitoring:
1. Provide AES-Intellinet wireless monitoring for fire alarm control panel:
 2. Manufacturer AES Corporation, Model 7788F.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
 3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- E. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- F. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- G. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
 - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 4. Integral Visual-Indicating Light: LED type, indicating detector has operated.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.6 CARBON MONOXIDE DETECTORS

- A. General: Carbon monoxide detector listed for connection to fire-alarm system.
 - 1. Mounting: Adapter plate for outlet box mounting.
 - 2. Testable by introducing test carbon monoxide into the sensing cell.
 - 3. Detector shall provide alarm contacts and trouble contacts.
 - 4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 - 5. Comply with UL 2075.
 - 6. Locate, mount, and wire according to manufacturer's written instructions.
 - 7. Provide means for addressable connection to fire-alarm system.
 - 8. Test button simulates an alarm condition.

2.7 NONSYSTEM SMOKE DETECTORS

- A. General Requirements for Nonsystem Smoke Detectors:
 - 1. Nonsystem smoke detectors shall be listed as compatible with the fire-alarm equipment installed or shall have a contact closure interface listed for the connected load.
 - 2. Nonsystem smoke detectors shall meet the monitoring for integrity requirements in NFPA 72.
- B. Single-Station Smoke Detectors:
 - 1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
 - 2. Auxiliary Relays: One Form C, rated at 0.5 A.
 - 3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.

4. Visible Notification Appliance: 177-cd strobe.
5. Test Switch: Push to test; simulates smoke at rated obscuration.
6. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
7. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
8. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
9. Integral Visual-Indicating Light: LED type, indicating detector has operated.

2.8 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Chimes: Vibrating type.
- C. Speakers: 25 or 70-V dc; with provision for housing the operating mechanism behind a grille. Speaker shall have frequency range of 400 to 4,000 Hz. Comply with UL 1480 and UL 1971.
- D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 1. Mounting: Wall mounted unless otherwise indicated.
 2. Flashing shall be in a temporal pattern, synchronized with other units.
 3. Strobe Leads: Factory connected to screw terminals.
 4. Mounting Faceplate: Factory finished, red.

2.10 ADDRESSABLE INTERFACE DEVICE

- A. General:
 1. Include address-setting means on the module.
 2. Store an internal identifying code for control panel use to identify the module type.
 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.
 1. Allow the control panel to switch the relay contacts on command.
 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:

1. Operate notification devices.
 2. Operate solenoids for use in sprinkler service.
- 2.11 ANNUNCIATOR GRAPHIC MAP
- A. Graphic Map:
1. Provide building floor plan at 1/8" =1'-0" scale with room names and all initiating devices with unique identifier included on map. Graphic map shall be installed within a custom painted aluminum frame with protective covering. Graphic map shall be installed adjacent to Fire alarm annunciator panel.
 2. Graphic map shall be approved by the AHJ prior to ordering and installation.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- C. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 2. Mount manual fire-alarm box on a background of a contrasting color.
 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm speaker and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 PATHWAYS

- A. Pathways shall be installed in EMT.
- B. Exposed EMT shall be painted red enamel.
- C. Where fire alarm cabling can be concealed above accessible ceilings open cabling may be utilized.

3.3 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the

device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Electronically locked doors and access gates.
3. Alarm-initiating connection to elevator recall system and components.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at elevator shunt-trip breaker.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform the following tests and inspections:
 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 46 21

DIVISION 31– EARTHWORK

Section 31 00 00	Earthwork.....	3
Section 31 11 00	Clearing and Grubbing.....	5
Section 31 22 16	Field & Track Subgrade Establishment	3
Section 31 23 00	Trenching, Backfill and Compacting	3
Section 31 46 22	Field & Track Imported Sands	2

SECTION 31 00 00 – EARTHWORK

PART 1 – GENERAL

1.1. SUMMARY

- A. Section includes site cutting, grading, filling, contouring, compacting, and preparation of site building pad and drive aisles.

1.2. REFERENCES

- A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 inch Drop.
- D. Soil in Place by the Rubber Balloon Method.
- E. ASTM D2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- F. ASTM D2434 - Test Method for Permeability of Granular Soils (Constant Head).
- G. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (shallow depth).
- H. Geotechnical Engineering Evaluation as prepared by GeoProfessional Innovation dated 8/18/2021.
- I. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge, and Municipal Construction, 2020, English edition and amendments to date (WSDOT Standard Specifications).
- J. Specification 32 8500 Landscape Grading

1.3. SUBMITTALS

- A. Samples: Submit, in air-tight containers, 45 lb. sample of each type of material borrow fill to testing laboratory.
- B. Materials Source: Submit name of imported materials source. Furnish materials of each type from same source throughout the Work. Change of source requires Engineer's approval.
- C. Classification according to ASTM D 2487 of each imported subsoil material proposed for fill and backfill.
- D. Laboratory compaction curve according to ASTM D 1557 for each imported subsoil material proposed for fill and backfill.
- E. Manufacturers' Literature and Data.
- F. Course Sand: 1-Quart volume of material; in sealed plastic bag labeled with composition of material and source.
- G. Topsoil: 1-Quart volume of material; in sealed plastic bag labeled with composition of material by percentage of weight and source.

1.4. CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.
- B. Field compaction test reports for all lifts of fill materials.

1.5. QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM and AASHTO procedure standards.
- B. Perform grading in accordance with the City of Richland grading permit requirements.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

- A. As noted in the geotechnical engineering evaluation as prepared by GeoProfessional Innovation dated 8/18/2021.

2.2 COARSE AGGREGATE MATERIALS

- A. Crushed Surfacing Top Course (CSTC): Conforming to Section 9-03.9(3) of the WSDOT Standard Specifications for top course.
- B. Crushed Surfacing Base Course (CSBC): Conforming to Section 9-03.9(3) of the WSDOT Standard Specifications for base course.

2.3 TOPSOIL

- A. Topsoil: Refer to Specification 32 8500 Landscape Grading.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions prior to beginning work.
- B. Review the geotechnical report recommendations as noted in the geotechnical engineering evaluation as prepared by GeoProfessional Innovation dated 8/18/2021.
- C. Verify intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities indicated to remain, from damage.
- D. Notify utility company to remove and relocate utilities.
- E. Protect above and below grade utilities indicated to remain.
- F. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- G. Protect bench marks, survey control points, existing structures, fencing and concrete apron from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

- A. All excavation shall be considered as unclassified.
- B. Do not process wet material to obtain optimum moisture content.
- C. Stability: Replace damaged or displaced subsoil as specified for fill.
- D. Remove all unsuitable and excess excavated soil materials from the school property to a location secured by the Contractor. The Contractor shall provide hauling, placement, compaction and all other associated processes to remove excess soil materials to an off-site location as secured by the Contractor at no additional costs to the Owner.
- E. All earthwork shall be performed in accordance the geotechnical engineering evaluation prepared by GeoProfessional Innovation dated 8/18/2021.
- F. Provide dewatering as necessary to install the improvements.

3.4 FILLING

- A. Scarify and compact the top 12 inches of existing subsoil subgrade to 92 percent of maximum dry density per ASTM D-1557, prior to placing any fill.
- B. Fill areas to contours and elevations with excess excavated sub-soils or imported sub-soils.
- C. Place fill material on continuous layers and compact in accordance with the geotechnical engineering evaluation as prepared by GeoProfessional Innovation dated 8/18/2021.
- D. Structural fill shall be placed in lifts and compacted to the following schedule:
 - 1. On-Site: To 95 percent of the maximum dry density per ASTM D-1557.
- E. Coarse aggregate materials (CSTC and CSBC) shall be placed in lifts and compacted to the following schedule:
 - 1. On-Site: To 95 percent of the maximum dry density per ASTM D-1557.
- F. Do not place fill material on top of uncontrolled fill.
- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Make grade changes gradual. Blend slope into level areas.
- I. Remove all surplus fill and/or excavated subsoil materials from site.

3.5 TOLERANCES

- A. Top Surface of Subgrade Building Pads, Track and Field Facilities, Site Improvement and Parking Area: Plus or minus 0.10 (1 tenth) foot from required elevation.
- B. Top Surface of Landscape Areas: Plus or minus 0.10 (1 tenth) foot from required elevation.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall coordinate with Owner's independent testing agency to perform field quality-control testing.
- B. Testing: In accordance with ASTM D1556, ASTM D1557, ASTM D2167, and ASTM D6938.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Compaction Tests for Structural Fill:
 - 1. Frequency shall be per Section 4 *Earthwork Testing* of the geotechnical engineering evaluation as prepared by GeoProfessional Innovation dated 8/18/2021.
 - 2. Provide a copy of the compaction test results to the Owner's Representative.
- E. Contractor shall notify the Richland School District representative for visual inspections of excavated subgrade of uncontrolled fills prior to placement of fill materials.

3.8 SCHEDULES

- A. Structural Fill:
 - 1. Maximum 12-inch loose lift depth.
 - 2. Compact in accordance with the geotechnical engineering evaluation as prepared by GeoProfessional Innovation dated 8/18/2021.

END OF SECTION 31 0000

SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Removing existing landscaping and irrigation where indicated and as located in the field.
 - 2. Clearing and grubbing.
 - 3. Stripping and stockpiling topsoil.
 - 4. Removing above- and below-grade site improvements.
 - 5. Disconnecting, capping or sealing, and abandoning site utilities in place and removing site utilities.
 - 6. Temporary erosion and sedimentation control measures.

1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site. Excess stripped topsoil materials that cannot be used shall also become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing. Submit prior to start of work.
- B. Traffic control plan for work on-site and in the public right of way.

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 3. Pedestrian Traffic: Provide alternate routes around closed or obstructed pedestrian walkways. Coordinate with the Richland School District.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 31 0000 "Earthwork."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of existing conditions before starting Work.
- B. Verify limits of site clearing prior to start of Work.
- C. Verify limits of tree protection fencing.

3.2 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.
- D. Conduct private utility locates within the construction area. Coordinate with RSD Owner's Representative to coordinate and schedule locates.

3.3 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Plan and execute construction to prevent erosion and sedimentation from leaving the site.
- B. Temporary erosion and sediment control is required for this project. The Contractor's attention is directed to the Plans and Sections 1-07.15 and 8-01 of the WSDOT Standard Specifications.
- C. The Contractor shall be responsible for all dust, erosion, and sediment control on the site. The contractor is to be familiar with the following requirements.
 - 1. Section 402(p) Federal Water Pollution Control Act (Clean Water Act).
 - 2. 40 CFR Parts 122, 123, and 124 (November 9, 1999) EPA Administration Permit Programs the NPDES.
 - 3. WDOE (Storm Water Permit Program General Permit for Storm Water Discharges Associated with Industries and Construction).
 - 4. "Storm Water Management Manual for the Eastern Washington" Latest Version.
 - 5. Benton County Clean Air Authority Fugitive Dust Policy.
 - 6. Project Permits.
- D. During the life of the contract the contractor will be required to provide reasonable erosion control measures to prevent, control, and stop water pollution, erosion or dust pollution which could adversely affect adjacent properties.
- E. Controlling erosion may require the contractor to perform temporary work including but not limited to the following:
 - 1. Providing ditches, berms, silt fencing, culverts, and other measures to control surface runoff water.
 - 2. Controlling silt build-up in storm drainage collection structures.
 - 3. Covering and/or otherwise protecting slopes and disturbed areas until such time that permanent erosion control measures are established.
- F. The Contractor shall be responsible for obtaining and complying with all local, State, and Federal permits required for stormwater pollution prevention as a result of construction activities.
- G. Obtain an Environmental Protection Agency's NPDES General Permit for Storm Water Discharges Associated with Construction Activity (otherwise known as the Construction Stormwater General Permit or CGP). The Permit is administered through the Washington State Department of Ecology for this project. Apply for an NOI. The CGP may be found on the Internet at: <http://www.ecy.wa.gov/programs/wq/stormwater/construction/permit.html>
- H. The General Contractor will be responsible for permit coverage from start to end of construction.

- I. The CGP does not relieve the Contractor from compliance with other regulations or contract requirements regarding stormwater pollution prevention including but not limited to: protection of surface waters, prevention of soil runoff into drains, dust control, prevention of tracking soils to adjacent streets, fuel containment, spill control, etc.
- J. The General Contractor shall be responsible to prepare a Stormwater Pollution Prevention Plan (SWPPP) for this project. The General Contractor shall review and be familiar with the SWPPP. The Contractor shall update the SWPPP as necessary for compliance with the CGP. Temporary Erosion and Sediment Control Plans have been provided in the construction plans for use by the Contractor. The SWPPP shall be on-site for the duration of the project.
- K. A minimum five (5) days prior to beginning construction, the General Contractor shall provide a SWPP outlining their proposed temporary water pollution/erosion and sediment control procedures and methods to the Richland School District. The information provided shall include, but not be limited to the following:
 - 1. A description of the intended sequence of major activities that disturb soils in major portions of the site.
 - 2. Estimates of the total area of the site that is expected to be disturbed by excavation, grading, or other activities.
 - 3. Description and details of the Best Management Practices (BMP's) which will be used to control erosion and sedimentation on the site over and above those shown on the Plans. Select and install BMP's to protect adjacent properties and surface waters from erosion and sedimentation. The BMP's will identify each of the major activities identified above, the appropriate control measures for each activity, and the timing during the construction process that the BMP's will be implemented and removed.
 - 4. Non-Erosion and Sediment Control BMP's. Provide written description, methods, and procedures for implementing BMP's used to control pollutants, other than sediment, from areas that can be a source of such pollutant. Such areas include equipment washdown, maintenance and refueling areas, materials storage areas, and waste disposal areas.
 - 5. Other information as required by the Construction General Permit and SWPP Guidelines.
- L. The Contractor shall submit Notice of Termination after Project Completion and Final Stabilization has been established.

3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
- C. Excavate for and remove underground utilities indicated to be removed. Backfill and compact area of removed utility in accordance with Section 31 0000 "Earthwork".

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.

4. Use only hand methods for grubbing within tree protection zone.
 5. Chip removed tree branches and dispose of off-site.
 6. Remove vegetation, mulch, soil and roots to a minimum of 8-inches in shrub beds that will be replanted to allow for placement of new topsoil and amendment.
 - B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 1. Place fill material in horizontal layers not exceeding a loose depth of 8-inches and compact each layer to a density equal to adjacent original ground.
 - C. Do not disturb or remove off-site field vegetation until ready to install underground utilities.
- 3.6 TOPSOIL STRIPPING
- A. Remove sod, grass and all other vegetation before stripping topsoil.
 - B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
 - C. Stockpile topsoil materials away from edge of excavations, at location indicated or where directed by Owner and/or Owner's Representative, without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Limit height of topsoil stockpiles to 72 inches unless OTHERWISE APPROVED BY Owner and or Owner's Representative.
 2. Topsoil stockpile shall not contain soils and/or debris that does not meet the Topsoil material requirements as specified in Specification 32 8500 Landscape Grading. Contractor shall be responsible to remove and dispose of all soils, debris and other miscellaneous materials that are not acceptable at no additional cost to the Owner.
 3. Contractor shall sort and/or screen topsoil stockpile to meet material requirements prior to placement.
 4. Stockpile location shall be approved by the Owner prior to placing materials. Stockpile locations that are not approved shall be moved at the Contractor's expense.
- 3.7 SITE IMPROVEMENTS
- A. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.
 - B. Remove slabs, paving, concrete retaining walls, concrete footings, fence posts, sidewalks, curbs, gutters, fencing and other miscellaneous items as indicated.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
- 3.8 DISPOSAL
- A. Disposal: Remove all surplus excavated soils and topsoil materials, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
 1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.
 2. Disposal waste sites shall meet all requirements of governing Health Department and Chapter 173-304 WAC.
 3. Refer to Construction Waste Management and Disposal Requirements.
 4. Contractor shall remove and dispose of excess topsoil materials that are stockpiled on-site at no additional cost to the Owner.

3.9 CLEANUP

- A. Upon completion of site Work and project, clean the entire Work area. Remove all excess excavated soil and topsoil materials, rocks, boulders, logs, trees, pipe or debris of any type and dispose from the site.

END OF SECTION 31 1100

31 22 16 FIELD & TRACK SUBGRADE ESTABLISHMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, material and equipment for subgrade establishment for all competition and adjacent areas including running track, field events, synthetic turf, and associated non-competition surfaces. Work includes but is not limited to the following:
 - 1. Layout and engineering;
 - 2. Surface water and erosion control;
 - 3. Management of the construction sequencing and scheduling relative to soil moisture content and the use of approved material as fill;
 - 4. Excavation, filling, back filling and compacting;
 - 5. Subgrade scarification, drying, and re-compaction as required;
 - 6. Compaction, compaction testing, and establishment of subgrade;

1.2 EXISTING SITE CONDITIONS

- A. Refer to drawings for topographical and existing condition information and the geotechnical report for site subsurface soil conditions.
- B. Carefully maintain benchmarks, monuments and other reference points. If disturbed or destroyed, replace as directed. It is the responsibility of the Contractor to familiarize themselves with all records of existing utilities in area of site work.
- C. The Contractor shall contact the Owner for identification of underground utility location.

1.3 TEMPORARY EROSION AND SILTATION CONTROL

- A. All work shall conform to the erosion and sedimentation control requirements of the local jurisdiction including installation of siltation control such as filter fabric fences, check dams, sedimentation basins, etc.
- B. Refer to the Site Preparation specification.

1.4 EXISTING UTILITIES

- A. The Contractor shall coordinate all existing utilities prior to proceeding with demolition and earthwork activity. Protect any active pipes encountered.

1.5 DUST CONTROL

- A. Protect persons and property from damage and discomfort caused by dust. Water as necessary to quell dust.

1.6 ROADWAY PROTECTION

- A. Provide wheel-cleaning stations to clean wheels and undercarriage of trucks before leaving site, as necessary to prevent dirt from being carried onto public streets. If streets are fouled, they must be cleaned immediately in conformance with the requirements of the local jurisdiction as applicable. This requirement applies to all vehicle movements for the entire period of construction.

1.7 TRAFFIC REGULATION

- A. Conduct operations in such a manner to avoid unnecessary interference to existing traffic. Minimize heavy vehicle traffic to and from site during peak traffic hours. Do not park vehicles in traffic lanes. Provide flagmen as required. Conform to traffic control

requirements of the local jurisdiction.

- B. Contractor shall be responsible for all traffic control and emergency call outs resulting from Contractor operations.
- C. Maintain fire lanes, roadways and alleys to existing buildings continuously, as required by the fire department having jurisdiction.
- D. Existing walkways and roadways leading past the construction shall remain clear and safe at all times. Provide barriers, flashing lights, walkways, guardrails and night lighting as required for safety and control.

1.8 RELATED WORK IN OTHER SECTIONS

31 10 00 Site Clearing
31 20 00 Earth Moving
32 12 18 Track Asphalt Paving
33 34 05 Field & Track Storm Drainage
33 46 16 Field & Track Subsurface Drainage
33 46 23 Field Permeable Aggregate

1.9 QUALIFICATIONS

- A. The subcontractor responsible for the Athletic Facilities subgrade establishment shall be submitted to the Engineer for approval upon request. Specific qualification requirements are included as follows:
 - 1. Contractor shall be and shall have been actively and directly engaged in constructing similar natural or synthetic field, track, and court projects for a period of five (5) or more years under the current business name and shall provide proof of successful completion of the following Outdoor Athletic Facilities;
 - a. Five (5) or more full size (minimum 75,000 SF) synthetic or sand-based natural grass field subgrade installations completed in the past three (3) years
 - b. Three (3) or more full-sized (six x42" lane) 400-meter polyurethane-surfaced track bases in the past five (5) years
 - c. Five (5) or more full-sized (minimum 4 contiguous doubles courts) tennis facilities in the past five (5) years.
 - 2. The Contractor's experience shall include completion of high school, college, or professional level competition fields.
 - 3. Other acceptable relevant work experience includes and base sand, root zone sand, or base aggregate placement and compaction for the relevant facilities-types listed.
- B. Provide a listing of all construction contracts (whether completed or in progress) entered into or performed by the subcontractor within the past five years for projects similar in scope, time and complexity to the work called for under this Contract; include current Owner/Facility Manager contact information.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 FIELD LAYOUT AND ENGINEERING

- A. The General Contractor shall be responsible for the vertical and horizontal layout of all work and control points required to construct all work in accordance with the drawings and specifications.

3.2 SEQUENCING AND SCHEDULING

- A. All new cut and fill areas shall be seal rolled at the end of each day to minimize moisture penetration.

3.3 EXCAVATED MATERIALS

- A. Strip surface to be disturbed of existing grass, brush, and any other organic plant material and dispose of off-site.
- B. Existing sand or other site fill material located on portions of the current field area may be re-used for fill below the softball field. All excess soil materials excavated to establish the required subgrade elevations shall be removed and disposed of off-site.
- C. All items of concrete, debris, piping, etc., are to be disposed of off-site at Contractor's expense and pre-arranged location. The Contractor shall make efforts to have the concrete and asphalt concrete paving recycled.

3.4 SUBGRADE

- A. All competition surface areas and adjacent areas of like construction and surfacing are to be compacted to at least 95% of maximum dry density by mechanical means as determined by ASTM D 1557-02. The Contractor shall be responsible for maintaining appropriate soil moisture prior to and during compaction activities, the cost of which is to be included in the contract price.
- B. Care must be exercised during grading of the subgrade so as to achieve a uniform, true surface relative to finish grade.
- C. Finish subgrade for the field shall be established to within the tolerance of +0.00' or - 0.10' of the design subgrade elevation for these areas.
- D. Fill must be select material, found on site below the existing field and free of organic matter, clay, concrete and other extraneous material, compactable to a minimum of 95% of the maximum dry density. Fill shall be placed and compacted in lifts of 12" maximum loose depth.
- E. Upon completion of the subgrade establishment and Contractor confirmation for conformance with the tolerance, the Contractor shall notify the Engineer and schedule an inspection for approval. The Contractor shall have a laser plane system with slope control available to the Engineer for the inspections. The Contractor shall not be authorized to install the subsurface drainage system until the subgrade has been inspected and approved by the Engineer.
- F. All other areas shall be compacted to a maximum of 90% of the maximum dry density. These areas shall be established to within the tolerance of +0.10' or - 0.10' of the design elevations and grades. All perimeter and swale areas shall be sloped in accordance with the grading plan. Swale grades shall include a constant slope between the designated high point and any catch basin rim elevations. Areas of ponding water in the swales shall not be accepted.

END OF SECTION

SECTION 31 23 00 - TRENCHING, BACKFILL AND COMPACTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes excavating trenches for utilities; compacted fill from top of utility bedding to subgrade elevations; and backfilling and compaction.

1.2 REFERENCES

- A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18-inch drop.
- D. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- E. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (shallow depth).
- F. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge and Municipal Construction 2016 and amendments to date, English edition.
- G. Revised Code of Washington (RCW), Chapter 49.17, Washington Industrial Safety and Health Act.
- H. Latest edition of the local jurisdictional governing agencies Standard Drawings and Specifications.
- I. Geotechnical Engineering Evaluation prepared by GeoProfessional Innovation dated 8/18/2021.

1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, cable or underground storage tank/structure.

1.4 SUBMITTALS

- A. Samples: Submit, in airtight containers, 45 lb. (20 kg) sample of each type of soil trench backfill material to testing laboratory. Submit test results to Engineer.
- B. Materials Source: Submit name and WSDOT Pit Identification Number of imported material suppliers. Provide materials from same source throughout the Work. Change of source requires Engineer's approval.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.6 COORDINATION

- A. Verify location and depths of existing utilities. Notify Engineer immediately of any conflict with existing utilities.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Backfill:
 - 1. In accordance with the Geotechnical Engineering Evaluation prepared by GeoProfessional Innovation dated 8/18/2021.
 - 2. Acceptable materials excavated from the trench in accordance with Section 7-08.3(3) of the WSDOT Standard Specifications. Material exceeding the optimum moisture content shall be considered as unacceptable for backfill within the pipe trench zone.

- B. Imported Fill: Imported subsoil in accordance with Section 31 0000.

PART 3 - EXECUTION

3.1 LINES AND GRADES

- A. Grades:
 - 1. Lay pipes to lines and grades indicated on Drawings.
 - 2. Maintain grade alignment of pipe using laser-beam instrument with qualified operator to establish lines and grades.
- B. Location of Pipe Lines:
 - 1. Location and approximate depths of proposed pipe lines and tanks are shown on Drawings.
 - 2. Engineer reserves right to make changes in lines, grades, and depths of pipe lines and manholes when changes are required for Project conditions.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCHING

- A. Trench excavation: In accordance with Section 7-08.3(1)A of the WSDOT Standard Specifications.
- B. Dewatering: Provide and maintain sufficient pumping equipment for removal of groundwater when encountered during trench excavation. Associated costs for dewatering to be included in the Contract Price. Lay no pipe or structures in standing water.
- C. Hand trim excavation: Hand trim for bell and spigot pipe joints. Remove loose matter.
- D. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.
- E. Protect open trench to prevent danger to the public and construction traffic.
- F. All trench excavation shall be considered as unclassified.

3.4 SHORING AND TRENCH SAFETY SYSTEMS

- A. Shoring to be in accordance with Section 7-08.3(1)B of the WSDOT Standard Specifications.
- B. Shoring and Trench Safety Systems shall meet the requirements of Washington State Industrial Safety and Health Act, Chapter 49.17 RCW.
- C. Repair damage caused by failure of the shoring, bracing or trench safety systems and for settlement of filled excavations or adjacent soil.
- D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate shoring, bracing or trench safety systems.

3.5 BACKFILLING

- A. Backfill in accordance with Section 7-08.3(3) of the WSDOT Standard Specification and the local jurisdictional governing agency Standard Specifications and as shown on the Drawings.
- B. Backfill trenches to contours and elevations indicated on the Drawings.
- C. Protect open trench to prevent danger to the public.
- D. Remove surplus fill materials from site.
- E. Leave fill material stockpile areas completely free of excess fill materials.
- F. Repair any damaged surface materials to match existing conditions or as noted in the drawings.

3.6 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 0.10 feet from required elevations.

3.7 FIELD QUALITY CONTROL

- A. Compaction Testing: In accordance with ASTM D1556, ASTM D1557, ASTM D2167, and ASTM D6938.
- B. Compaction: Compaction shall meet the requirements of Section 7-08.3(3) of the WSDOT Standard Specifications.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- D. Frequency of Tests: Tests shall be taken every 100 linear feet of trench at the following depths:
 - 1. 2-foot above the top of pipe.
 - 2. Increments of 2 feet vertical depth thereafter or finished subgrade whichever is lower.
 - 3. Minimum of 3 tests per utility alignment.

3.8 PROTECTION OF FINISHED WORK

- A. Protect finished work from damage.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 31 2300

SECTION 31 46 22 – FIELD & TRACK IMPORTED SANDS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install long/triple jump landing pit sand.
- B. Furnish and install shot put landing area cinder surfacing.

1.02 SUBMITTALS

- A. The Contractor shall submit to the Engineer for approval of current sieve analysis and the source of the imported sand and cinder materials proposed for use on the project. The sieve analysis shall include the same sieve sizes as those indicated in the specifications and shall be wet sieves as designated in the specifications.

1.03 RESERVE

1.04 TESTING

- A. The Contractor shall provide at least one Particle Gradation Test on each bulk product delivered to the project site as proof of conformance with the specifications. Sampling is to be performed under the direction of the Owner, Architect, or Engineer.

PART 2 MATERIALS

2.01 LONG/TRIPLE JUMP LANDING PIT & BASE SAND

- A. The material is intended to be sand oriented and limited in gravel and fines. The gradation stipulated is intended as a guide; therefore, minor variations may be permitted subject to approval by the Engineer of certified sieve sample analysis prior to and during placement of material.
- B. Material is to be light beige / white and uniform in color, texture, and mineral composition.
- C. Sand material gradation must meet the following sieve analysis:

<u>Sieve Size</u>	<u>% Passing</u>
No. 3/8"100	
No. 4	75 - 100
No. 100	0 - 10
No. 200 (wet sieve)	0 - 5
No. 270 (wet sieve)	0 - 2

- D. Source: Lane Mountain

2.02 SHOT PUT LANDING AREA

- A. Product shall be a pure red cinder material free of all foreign materials including dirt, gravel or rock of other origin, organic material or trash.
- B. Particle Gradation

<u>Sieve Size</u>	<u>% Passing</u>

# 4	100
#270 (wet sieve)	0 – 5

C. Source:

Cinder Butte Rock Products
8805 11th St.
Terrebonne, OR 97760
(541) 548-7607

Bishop Red Rock Inc
221 W Main St.
Goldendale, WA 98620
(509) 773-5335

Or approved equal.

PART 3 EXECUTION

3.01 LONG/TRIPLE JUMP PIT SAND

- A. Remove all debris and contaminants from the prepared subgrade of the concrete landing pit, and expose clean pea gravel drainage aggregate at the field subsurface drainage installation.
- B. Fill each pit with sand to within approximately 6" capacity and water settle aggressively, using a high-flow source such as a hydrant/fire hose or water truck or wagon. Allow to drain 12 hours. Verify complete drainage by potholing to the subgrade. Report any standing water to the Engineer and coordinate remedy before proceeding.
- C. Each pit shall be filled uniformly flush to the top of the curb. Strike off / Screed the pit sand to a uniform surface finish.
- D. Cover and protect the pit sand from contamination until Owner Occupancy.
- E. For covered pits, provide in quantities sufficient to fill the pit screed-level to the top of curb. Remove excess to accommodate pit covers. Coordinate storage of excess on site with the Owner.

3.02 SHOT PUT LANDING AREA SURFACING

- A. Cinders are to be placed on approved Granular Base Material / Base Sand per Paragraph 2.01 only.
- B. Stockpile or transfer imported cinder material in a clean environment. Foreign soil, gravel, stone, organic debris or other material will not be permitted in the finished profile.
- C. Place material so as to establish the minimum requirements of finish settled depth, as specified on the drawings, and finish grade entire surface to final elevations shown. Lightly water settle and roll to achieve consolidated settled depth.
- D. Add material as necessary to achieve finish grade. Apply moisture as necessary to settle for stabilization.
- E. Finish grade tolerance is +0.05' and -0.00' relative to grading plan. All finished surfaces must be of a constant slope resulting in smooth, even transitions between adjacent surfaces, generally the perimeter containment / fence line curb and sand based natural grass or infield soil. No depressions or "bird-baths" will be permitted.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 32 12 16	Asphalt Paving	3
Section 32 12 18	Track Asphalt Paving	3
Section 32 13 13	Site Concrete Work.....	4
Section 32 13 73	Concrete Paving Joint Sealants.....	2
Section 32 18 23	Rubberized Track Surfacing	7
Section 32 18 24	Synthetic Turf Surfacing.....	17
Section 32 31 14	Chain Link Fencing & Accessories	4
Section 32 84 00	Landscape Irrigation	12
Section 32 84 23	Field & Track Washwater Systems.....	9
Section 32 85 00	Landscape Grading.....	3
Section 32 92 00	Turf and Grasses	6

SECTION 32 12 16 - ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes asphaltic concrete paving and associated items.

1.2 REFERENCES

- A. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge and Municipal Construction 2020 and amendments to date, English edition (WSDOT Standard Specifications).
- B. Latest edition of the local jurisdictional governing agencies Standard Drawings and Specifications.
- C. Geotechnical Engineering Evaluation prepared by GeoProfessional Innovation dated 8/18/2021.

1.3 PERFORMANCE REQUIREMENTS

- A. On-Site Hot Mix Asphalt: WSDOT Commercial HMA Cl. ½ In PG 64-28.

1.4 SUBMITTALS

- A. Product Data: Submit product information and mix design.
- B. Certificate: Certify Products meet or exceed specified requirements.
- C. Mix design prepared in accordance with WSDOT mix design specification within the past twelve months of commencing paving.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with WSDOT Standard Specifications.
- B. Mixing Plant: Conform to WSDOT Standard Specifications.
- C. Obtain materials from same source throughout.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when ambient air or base surface temperature is less than in accordance with Section 5-04.3(16) of WSDOT Standard Specifications. Or when surface is wet or frozen.

PART 2 PRODUCTS

2.1 MATERIALS

- A. On-Site or Off-Site Asphalt Cement: Performance Grade PG 64-28. Supplier to be the same as shown on Mix Design.
- B. Aggregate for Mix: Gradation to meet requirements of the WSDOT Mix Design; HMA Cl. 3/8 or ½ in as shown on the Drawings.
- C. Anti-Strip: As required in Mix Design. Supplier to be the same as shown on Mix Design.
- D. Tack Coat: Emulsified asphalt CSS-1 or STE-1 meeting the requirements of WSDOT Standard Specifications.
- E. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or removal of existing asphalt concrete pavements.
- F. Coarse Aggregate Crushed Surfacing Top Course and Base Course: As specified in Section 31 000.
- G. Soil Residual Herbicide: Currently registered with the Washington State Department of Agriculture or as approved by Engineer.

2.2 ASPHALT PAVING MIX

- A. On-Site: Hot Mix Asphalt: WSDOT Commercial HMA Cl. ½ in.

1. On-Site HMA is defined as located inside the Richland School District property limits.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design for review prior to beginning of Work.
- B. Test samples in accordance with WSDOT Standard Specifications.

2.4 ACCESSORIES

- A. Pavement Markings
 1. On-Site (Private) and Off-Site (Public) shall be either Low VOC Solvent Base or Low VOC Waterborne meeting the requirements of WSDOT Standard Specifications Section 9-34.
- B. Sign post shall consist of a two part, breakaway system made of a 2" X 2", 12 gage, galvanized square steel tube post with a one-piece anchor base made of 2.25" X 2.25", 12 gauge, 36" long, galvanized square tube steel by TELSPAR® or approved equal unless otherwise noted.
- C. All signage shall be in accordance with the latest edition of the MUTCD and the Washington State Sign Fabrication Manual. Type and size of signs are noted in the plans.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting Work.
- B. Verify compacted aggregate subbase is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

3.2 SUBBASE PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared subgrade to total compacted thicknesses as indicated on the Drawings.
- B. Place aggregate in maximum 4-inch layers and compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Re-grade and compact areas disturbed prior to placement asphalt concrete pavement.

3.4 HERBICIDE

- A. Apply soil residual herbicide on finished aggregate areas no sooner than 24 hours prior to placement of hot mix asphalt. Apply uniformly in accordance with the manufacture's recommendations for 3-inch penetration. Apply only on surfaces to be paved.
- B. Soil residual herbicide to be applied by applicator licensed in the State of Washington.

3.5 PREPARATION - TACK COAT

- A. Prepare existing paved surfaces and apply tack coat in accordance with Section 5-04.3(5)A of WSDOT Standard Specifications. Apply at rate of 0.02 to 0.08 of retained asphalt.
- B. Coat cement concrete surfaces that will be in contact with pavement. Protect cement concrete surfaces from exposed cement concrete surfaces form tack application method. Clean excess tack from exposed cement concrete surfaces.

3.6 PLACING ASPHALT PAVEMENT

- A. Apply soil residual herbicide prior to paving.
- B. Install Work in accordance with Section 5-04 of WSDOT Standard Specifications.
- C. Place to compacted depths identified in schedule at end of Section.

- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- 3.7 PLACING OF ACCESSORIES
- A. Pavement Markings: Shall be in accordance with Section 8-22 of the most current edition of the WSDOT Standard Specifications.
 - B. Signage: Shall be installed vertically plumb and as per the detail in the Drawings.
- 3.8 TOLERANCES
- A. Surface Smoothness: Maximum variation of 1/8 inch measured with 10-foot straight edge parallel to the direction of paving and 1/4 inch measured with a 10-inch edge perpendicular to the direction of paving.
 - B. Scheduled Compacted Thickness: Within 1/8-inch.
 - C. Variation from Indicated Elevation: Within 1/4-inch.
- 3.9 FIELD QUALITY CONTROL
- A. Samples taken and test performed in accordance with WSDOT Standard Specifications.
 - B. Frequency of testing shall be per the Geotechnical Engineering Evaluation prepared by GeoProfessional Innovation dated 8/18/2021.
- 3.10 PROTECTION OF FINISHED WORK
- A. Protect pavement from unnecessary traffic.
- 3.11 SCHEDULES
- A. Asphalt pavement section as shown in the drawings. Compact course to 91 percent of maximum theoretical (Rice) density.

END OF SECTION 32 1216

32 12 18 TRACK ASPHALT PAVING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Include all labor, material, transportation and services to complete installation of the aggregate base and asphalt paving as shown on the drawings for the running track, field event areas, and adjacent non-competition areas:
 - 1. Final subgrade establishment
 - 2. Base course aggregate
 - 3. Track Asphalt Concrete paving (2 lifts)

1.2 STANDARD SPECIFICATIONS

- A. All sections of the standard specifications applicable to any and all parts of this project shall govern, except as specifically modified in these contract documents.
 - 1. Washington Department of Transportation (WDOT) Standard Specifications.
 - 2. American Public Works Associations, Standard Specifications for Municipal Public Works Construction, (APWA), latest edition.
 - 3. American Society for Testing and Materials (ASTM)
 - 4. American Association of State Highway and Transportation Officials, (AASHTO).

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- 31 20 00 Earth Moving
- 31 22 16 Field & Track Subgrade Establishment
- 32 13 13 Concrete Paving
- 32 18 23 Track Rubberized Surfacing

1.4 QUALIFICATIONS

- A. The subcontractor responsible for Track Asphalt Paving shall be submitted to the Engineer for approval upon request. Specific qualification recommendations are included as follows:
 - 1. Contractor shall be and shall have been actively and directly engaged in constructing similar natural or synthetic field, track, and court projects for a period of five (5) or more years under the current business name and shall provide proof of successful completion of the following Outdoor Athletic Facilities;
 - a. Three (3) or more full size (minimum 75,000 SF) synthetic turf field base installations completed in the past five (5) years (porous or standard asphalt).
 - b. Three (3) or more full-sized (six x42" lane) 400-meter polyurethane-surfaced track bases in the past five (5) years (porous or standard asphalt).
 - c. Five (5) or more full-sized (minimum 4 contiguous doubles courts) tennis facilities in the past five (5) years.
 - 2. The Contractor's experience shall include completion of high school, college, or professional level competition fields.
- B. Provide a listing of all construction contracts (whether completed or in progress) entered into or performed by the subcontractor within the past five years for projects similar in scope, time and complexity to the work called for under this Contract; include current Owner/Facility Manager contact information. Running Track Asphalt Base for Rubberized Track Surfacing successful installation to be documented by the rubberized surfacing provider/installer.

1.5 SUBMITTALS

- A. Submit to the Architect for approval:
 - 1. Base course aggregate sieve analysis

2. Equipment and procedures to be utilized for the asphalt installation.
3. Asphalt mix design or composition.
4. Previous experience of the proposed asphalt installation foreman as described above.

PART 2 MATERIALS

2.1 ASPHALT CONCRETE PAVING

- A. All machine-placed asphalt concrete pavement shall be either Class 3/8" HMA or Class 1/2" HMA. All hand-placed asphalt pavements shall be Class 3/8" HMA.
- B. Running track pavement section from approved subgrade to be 3-1/2" compacted depth, placed on a minimum depth of 6" aggregate base. The running track asphaltic concrete pavement shall be installed in 2 lifts. The first lift shall be a minimum 2" compacted depth of Class 1/2" HMA and the second lift shall be a minimum 1-1/2" compacted depth of Class 3/8" HMA.
- C. Weather limitations: Construct asphalt paving only when atmospheric temperature is above 40 degrees F., when underlying base is dry and weather is not rainy.
- D. Grade control: Establish and maintain the required lines and grades and cross-slope.

2.2 AGGREGATE BASE MATERIAL

- A. For Track Asphalt Paving base, WDOT CSBC. The Contractor may, with approval, utilize a WDOT CSTC leveling course in substitution of up to 2" of the designed CSBC base.

PART 3 EXECUTION

3.1 SUBGRADE

- A. Establish subgrade and thoroughly compact to minimum 95% of maximum dry density.

3.2 AGGREGATE BASE

- A. Place aggregate base only to existing compacted surface. Apply aggregate base and compact to a uniformly smooth hard surface with a minimum thickness of 6" or greater as required to conform to lines, grades and cross sections as shown or directed. Compact to a minimum of 95% of maximum dry density.

3.3 ASPHALTIC PAVING

- A. The grade tolerance of the compacted first lift of asphalt shall be +1/4" and -0". The asphalt concrete base shall not deviate from the true surface in excess of 1/4" on a 10' straight edge in all directions.
- B. For the running track, the surface elevation of the final lift of paving in the compacted condition, shall not deviate more than 1/4" from specified elevations. Trueness measurement to be taken from 10' long straight edge placed in all directions.
- C. All edges to be flush to adjacent containment within 1/8". No reverse slopes or birdbaths will be allowed. The complete surface of the asphalt shall be of uniform texture, smooth uniform as to grade, and free from defects of all kinds. Verify elevation requirements prior to commencing paving.

3.4 HAND PLACING

- A. Spread, tamp, and finish mixture using hand tools in areas where machine spreading is not practical.

- B. Place mixture at rate that will ensure handling and compacting before mixture temperature drops below 230 degrees F.
- C. Edges must have a straight or continuous smooth line.

3.5 QUALITY CONTROL

- A. Contractor shall coordinate inspections of the finished aggregate base course, initial asphalt pavement course, and finished asphalt paving course with the Engineer for verification of compliance with the specifications prior to proceeding with the next task or demobilizing from the job site.
- B. Prior to acceptance, all pavement shall be exposed to a "flood" test. When deviations in excess of the tolerances noted above or obvious depressions (birdbaths) are found, the pavement surface shall be corrected by the addition of asphalt concrete mixture of an appropriate class to low places or the removal of material from high places by methods satisfactory to the Architect or by removal and replacement of the asphaltic concrete.
- C. Deficiencies that are found to be higher than the specified tolerance shall be removed using micro-grinding techniques, grinding and re-paving, or cutting and patching as approved.
- D. Deficiencies found to be lower than the specified tolerance but less than twice the diameter of the largest mix design aggregate particle shall be referred to the Rubberized Surfacing Contractor for fill using a sand/urethane matrix shim coat.
- E. Corrections of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances. All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the Architect's satisfaction.

3.6 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphaltic materials.

3.7 PROTECTION

- A. Protect asphaltic paving from all damage of every kind. Do not permit vehicular traffic on asphaltic paving until it has cooled and hardened and in no case sooner than six hours after placing.
- B. Provide barricades and warning devices as required. Protect soil and other site features where asphalt is being laid.

END OF SECTION

SECTION 32 13 13 – SITE CONCRETE WORK

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes cement concrete for sidewalks, paving, curb and gutter, retaining walls and concrete work associated in the track and field event areas.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 4. ACI 347 – Guide to Formwork for Concrete.
 - 5. AASHTO M-36 - Corrugated Metal Culvert Pipe.
 - 6. ASTM A53 - Pipe, steel, black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - 7. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- B. ASTM International:
 - 1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 2. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - 3. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 4. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 5. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 - 6. ASTM C150 - Standard Specification for Portland Cement.
 - 7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 8. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 9. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
 - 10. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - 11. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 12. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- C. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge and Municipal Construction 2020 and Amendments to Date, English Edition.
 - 1. Section 5-05 – Cement Concrete Pavement
- D. RELATED SPECIFICATION SECTIONS
 - 1. 11 68 24 Field & Track Equipment & Furnishings
 - 2. 32 12 18 Track Asphalt Paving
 - 3. 32 18 23 Track Rubberized Surfacing
 - 4. 32 18 24 Field Synthetic Turf
 - 5. 32 31 13 Chain Link Fences and Accessories

1.3 SUBMITTALS

- A. Cement Concrete Product Data: Submit product information, materials and mix design.

- B. Cement concrete mix design: Submit a minimum of 10 working days prior to start of any placement.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and the requirements of Section 03 3000 and Section 5-05 of the WSDOT Standard Specifications.
- B. Maintain one copy of each document on site.
- C. Obtain cementitious materials from same source throughout.
- D. Conform to ACI 305 when concreting during hot weather.
- E. Conform to ACI 306.1 when concreting during cold weather.
- F. Concrete planarity and gradient uniformity tolerances are to conform to those of adjacent or overlying systems or materials including synthetic turf and rubberized track surfacing.

PART 2 PRODUCTS

2.1. FORM MATERIALS

- A. Form Materials: Conform to ACI 301 and as specified in Section 03 3000.
- B. Bituminous Joint Filler per ASTM D1751.

2.2 CONCRETE MATERIALS

- A. Concrete Materials: As specified in Section 03 3000 and Section 5-05-.2 Materials of the WSDOT Standard Specifications.
- B. Cement: ASTM C150, Type I-II Portland type.
- C. Aggregates: 1-1/2" to 3/4", 3/4" to #4, 3/8" to #8.
- D. Sand: ASTM Concrete Sand; ASTM Mortar Sand.

2.3 ACCESSORIES

- A. On-Site Concrete Curbing, barrier or curb and gutter, shall be Class 4000 psi after 28 days and shall be 6 inches in height and per the detail in the Drawings.
- B. On-Site Cement concrete Sidewalk shall be Class 4000 psi after 28 days cement concrete and per the detail in the Drawings.
- C. Curing Materials: As specified in Section 03 3000 and per Section 5-05.2 Materials of the WSDOT Standard Specifications.
- D. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- E. Bonding Agent: ASTM 1059, Type II, non redispersible, acrylic emulsion or styrene butadiene.
- F. Joint Sealers: As specified in Section 03 3000.
- G. Off-Site Cement located in the City public right of way shall be in accordance with the City of Richland standard details and specifications.
- H. Retaining walls shall be Class 4000 psi after 28 days and per the detail in the Drawings.

2.4 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94/C94M.
- B. Select proportions for normal weight concrete in accordance with ACI 301.
- C. Provide concrete to the following criteria:
 - 1. Compressive Strength: 4000 psi at 28 days, unless noted otherwise.
 - 2. Slump: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 - 3. Minimum Cement Content: 6.5 sacks per cubic yard.
 - 4. Maximum Water/Cement Ratio: 0.43 (non-air entrained), 0.35 (air entrained).
 - 5. Air Entrained: 6 percent, plus or minus 1.0 percent at point of delivery for 1 inch or 3/4-inch nominal maximum aggregate size.
 - 6. Use accelerating admixtures in cold weather only when approved by the Architect/Engineer in writing. Use of admixtures will not relax cold weather placement requirements.
 - 7. Use calcium chloride only when approved by the Architect/Engineer in writing.

8. Use set retarding admixtures during hot weather only when approved by the Architect/Engineer in writing.

2.5 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets and as shown on Drawings.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet and as shown on Drawings.
- C. Reinforcing Bars: ASTM A 615, Grade 60; deformed and as shown on Drawings.
- D. Dowel Bars: ASTM A 615, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

2.6 SOURCE QUALITY CONTROL AND TESTS

- A. Provide mix design for cement concrete.
- B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of Work.
- C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.
- D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of existing conditions before starting Work.
- B. Verify compacted subgrade and granular base and/or top courses are acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
 1. Account for finished surface materials within the Track & Field event areas that may contain rubberized surfaces, synthetic turf or other finishes.

3.2 SUBBASE

- A. Course Aggregate Subbase: Install as specified in Section 31 0000 and as per the detail in the Drawings

3.3 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manholes, catch basins and all other structures to be adjusted to finished grade with oil to prevent bond with concrete pavement.
- C. Notify Owner and/or Owner's Representative a minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

- A. Place reinforcement as detailed on the Drawings.
- B. Interrupt reinforcement as detailed on the Drawings.

- C. Place dowels and reinforcement to achieve pavement and curb alignment as detailed on the Drawings.
- D. Provide doweled joints as indicated with one end of dowel set in capped sleeve to allow longitudinal movement.

3.6 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301 and as specified in Section 03 3000.
- B. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
- C. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- D. Place concrete within the vertical and horizontal tolerances associated with the Track & Field Event areas and their associated adjacent and overlying materials.

3.7 JOINTS

- A. Place expansion and contraction joints. Align curb, gutter, and sidewalk joints.
- B. Joints shall be uniform in shape and size.
- C. Avoid long/narrow and irregular joint patterns.
- D. Place joint filler between paving components and building or other appurtenances.
- E. Saw cut contraction joints at an optimum time after finishing.

3.8 FINISHING

- A. Concrete Paving: Light broom.
- B. Sidewalk Paving: Light broom and trowel joint edges.
- C. Curbs and Gutters: Light broom.
- D. Direction of Texturing: Transverse to pavement direction.
- E. Retaining Walls: Sack finish on exposed surfaces.
- F. Place curing compound and sealer on exposed concrete surfaces immediately after finishing.

3.9 JOINT SEALING

- A. Separate pavement from vertical surfaces with ½-inch thick joint filler.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- C. Extend joint filler from bottom of pavement to within ¼-inch finished surface. Conform to Section 03 3000 for finish joint sealer requirements.

3.10 FIELD QUALITY CONTROL

- A. Shall be in accordance with Specification 033000 section 3.15 Field Quality Control.
- B. Concrete planarity and gradient uniformity tolerances conforming to those of adjacent or overlying systems or materials.

3.11 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian and vehicular traffic over pavement until minimum strength is achieved.

END OF SECTION 32 1313

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold-applied joint sealants.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, eight, Samples of materials that will contact or affect joint sealants. Use manufacturer's standard test method to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Pavement-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- D. Product certificates.
- E. Product test reports.
- F. Preconstruction compatibility and adhesion test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.
- B. Pre-installation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- B. Backer Strips for Cold -Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-Sag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- H. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 32 13 73

32 18 23 RUBBERIZED TRACK SURFACING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Base Bid Running Track & Field Event Surfacing: Include all labor, material, equipment, transportation, and services for the synthetic turf elastic layer pad system and the rubberized track and field event surfacing including the following:
 - 1. Furnish and install a complete all-weather rubberized running track and field event area surfacing over the track asphalt paving substrate as shown on the drawings and as specified herein. The rubberized running track surfacing system shall include:
 - a. The surfacing shall be a base mat and red structural spray system. It shall include a rubber base mat bound with polyurethane paved over track asphalt paving. All areas of rubberized surfacing shall include a top coating of single component polyurethane red pigmented coating with red EPDM rubber granules. The top coating of the running track shall be applied in two applications.
 - b. All rubberized surfacing shall be permeable.
 - c. Provide painted lines and striping as specified.
 - d. The surface of all rubberized surfaces must have homogeneous texture. All areas, such as abutting seams that do not have uniform texture must be cut out and resurfaced with acceptable texture and finish appearance.
 - e. Apply rubberized surfacing system to the long jump take off boards.
 - f. Warranty package

1.2 STANDARD SPECIFICATIONS

- A. Track and Field Rules, latest edition of the National Federation of State High School Associations (NFSHSA, as adopted by the WIAA).

1.3 PRE-APPROVED VENDORS/INSTALLERS

- A. The following vendors/installers are pre-approved for installation of the rubberized running track and field event surfacing the elastic layer pad system.
 - 1. Beynon Sport Surfaces (800) 423-5875
 - 2. Hellas Construction (512) 250-2910
 - 3. Coast-to-Coast Turf / Rekortan (509) 953-1607

1.4 SUBMITTALS

- A. Experience, References, and Installation:
 - 1. All vendors which are not pre-approved shall submit written evidence of a five-year minimum successful experience record of Manufacturer/Supplier/ Installation team in the installation of a minimum of ten (10) similar projects that include polyurethane synthetic track surfacing. List locations, client, client contact names, address, telephone, material installed, date of installation, general contractor (if any), whether a new project or a resurfacing. The material manufacturer must have a minimum of 5 years of experience with polyurethane for athletic surfaces. Track vendors/ installers with less than this minimum experience record are not acceptable.
 - 2. A minimum of 30 calendar days prior to the scheduled commencement of the surfacing installation, the Contractor shall submit to the Engineer the name of track marking subcontracting firm and surveyor, their proposed foremen and key personnel, along with their experience record. The Engineer must approve the marking subcontractor.
- B. Track Striping Shop Drawings
 - 1. The Contractor shall submit a minimum of 30 calendar days prior to the scheduled commencement of the surfacing installation, complete and detailed track striping and

- marking plan.
2. This shop drawing is for Owner and Engineer review. The Contractor is not to proceed with painting until the drawing is approved by Engineer or, as may be required, resubmitted for approval with revisions.
- C. Manufacturer's Specifications: Within 21 calendar days after Notice to Proceed, the Contractor/Vendor shall submit to the Engineer for approval five copies of each of the selected manufacturer's surfacing material specifications and installation instructions.
- D. Sample Warranty Package: Within 21 calendar days after Notice to Proceed, submit to the Engineer for review five (5) sample copies of the surfacing warranty package herein specified.
- E. Maintenance and Operating Data:
1. Furnish to the Engineer, in manual form, four (4) copies of maintenance and operating data prior to final Substantial Completion.
 2. Manual shall be enclosed in a hard cover with the following information appearing on the outside of the cover: Project name, Owner's name, Engineer's name, Contractor's name, Rubberized Surfacing Subcontractor's name, and Year of project completion
 3. Index manual with tab dividers for data as follows:
 - a. Contact information – Include firm name, contract name, address, telephone number, and email address for each firm identified on the Manual cover.
 - b. Materials installed with their characteristics
 - c. General maintenance
 - d. Lining and marking installation
 - e. Lining and marking removal
 - f. Small repair procedures
 - g. Discussion on precautions to be practiced and general maintenance and procedures to be avoided to prolong surface life and to maintain installation's warranty.
 - h. Copy of warranty document

1.5 QUALITY CONTROL

- A. Area and Base Acceptance:
1. The Surfacing Subcontractor/Installer (if applicable) shall inspect, verify and accept in writing to the Prime Contractor, with a copy to the Engineer, all installed work of other trades directly affecting the work of this section.
 2. Installer must examine the areas and conditions in which rubberized surfacing is to be installed. The track asphaltic paved base for the rubberized surfacing shall be inspected for conformity with the lines and grades.
 3. The installer is to coordinate the required curing of any new asphalt concrete paving with the Prime Contractor prior to placing the first lift of rubberized surfacing.

1.6 TESTS

- A. The Owner reserves the right to submit the surface system to various tests to verify whether or not surfacing system meets the minimum specifications or manufacturer's submitted specifications. Any section of the system so tested that is found to not be in compliance with specification requirements shall be removed and replaced to the proper specification, at the sole expense of the Contractor.

1.7 TRACK & FIELD EVENT SURFACING WARRANTY

- A. In addition to the general warranty specified in the General Conditions of the specifications, an additional four-year vendor warranty (5-year total) for the rubberized surfacing system shall be provided to the Owner by the track surfacing vendor, protecting Owner against all manufacturing, material and installation defects associated with materials and workmanship under this section. Warranty to extend from date of Substantial Completion.

- B. Warranty shall cover in general the usability of the installed surfacing system, accessories use characteristics, suitability of the installation for the period specified, and for the designated uses enumerated as follows:
1. Track and field events with spiked shoes
 2. Physical exercises
 3. Physical education activities
 4. Marching band
 5. Cheerleading activities
 6. Access to adjacent football/soccer field
 7. Pneumatic rubber-tired maintenance and service vehicles
 8. Pedestrian traffic and other similar uses
 9. Community running and jogging
 10. Wheelchair traffic
- C. Conditions of Warranty: Warranty shall agree to promptly repair or replace work, which deteriorates excessively or otherwise fails to perform as required due to failures of materials and workmanship. Striping and other painted markings are excluded from the warranty. For the purposes of this warranty, excessive deterioration is defined as a loss of fifty (50%) of the wearing surface or granular loss. Failure of material and workmanship is defined to include, but is not limited to, delaminating of the track from its track asphaltic concrete base, or from integral layers of surfacing material, and leaching of binders or other surfacing components. All defects are to be promptly repaired. If the warrantor does not initiate repair work within 21 calendar days from receipt of complaint in writing, adverse weather conditions excepted, the Owner shall have the right to order the work performed by others and the warrantor shall be liable for costs accruing to the Owner.
- D. The parent company or corporation of the track surface installation firm shall issue the warranty. The warranty shall be signed by an authorized principal of the applicable firm, duly-authorized to make contracts.
- E. A separate warranty from the Contractor, the Track Installer and the Striping Subcontractor shall be issued for the marking and striping guaranteeing applied painting for a period of two (2) years from fading in color and intensity plus cracking or separating from the track surface.

PART 2 PRODUCTS

2.1 TRACK & FIELD EVENT SURFACING COMPOSITION

- A. The base mat shall be composed of SBR rubber granules and single component polyurethane binder. The base mat layer shall be a minimum of 12.0mm thick.
- B. Top layer for all areas shall be a red pigmented blend of EPDM rubber granules and single component polyurethane. The top layer shall be two structural spray coats totaling a minimum 1.5 mm thickness for all areas.

2.2 TRACK & FIELD EVENT SURFACING BASE MAT COMPOSITION

- A. A primer shall be applied to the track asphaltic concrete pavement base and adjacent concrete edging prior to installation of the base mat. The primer shall be polyurethane base as specified by the surfacing system manufacturer.
- B. The base mat shall be composed of SBR rubber granules and single component polyurethane binder. The base mat shall be comprised of a maximum of 80% SBR and a minimum of 20% single component polyurethane by weight. The paved-in-place base layer shall be installed to a minimum depth of 12.0 mm thickness.

C. SBR Rubber Granules:

1. The granules shall be recycled styrene butadiene rubber (SBR). There shall be no traces of fiber or steel with granulate. The material shall be sourced from North American manufacturing.
2. Granulate particles shall meet the following gradation requirements:

<u>Particle Size</u>	<u>Percentage by Weight</u>
0-1.0mm	3.5%
1.0-2.0mm	15-25%
2.0-3.0mm	30-40%
3.0-4.0mm	30-40%
Larger than 4.0mm	0-5%

D. Polyurethane Binder:

1. For the base layer utilize single component polyurethane.
2. No mercury, lead or other heavy metals are to be present. No solvent or fillers are to be added.
3. The polyurethane binder shall be manufactured in North American or Western Europe by a manufacturer.

2.3 TRACK & FIELD EVENT SURFACING STRUCTURAL SPRAY SYSTEM TOP COAT

- A. The top coat shall be comprised of two structural spray coats. The structural spray coats shall be comprised of a blend of pigmented EPDM rubber granules and pigmented single component polyurethane. The two structural spray coats shall be applied at a rate totaling 3.0 lbs/sy and providing a minimum 1.5 mm thickness for all areas.
- B. The binder for the structural spray coats shall be a single component pigmented polyurethane. No mercury, lead or other heavy metals are to be present. No solvent or fillers are to be added. The polyurethane shall be manufactured in North American or Western Europe by a manufacturer.
- C. The granulate for the structural spray shall be composed of peroxide cured Ethylene Propylene Dien Polymerisat (EPDM) rubber. For the first structural spray coat half of the granules are to be graded from 0.5 mm to 1.5 mm in size and half of the granules are to be 1.0 mm to 3.0 mm in size. For the second structural spray coat all of the granules are to be graded from 0.5 mm to 1.5 mm in size. The EPDM granules shall meet the following requirements:
 1. The granules shall be composed of peroxide cured Ethylene Propylene Dien Polymerisat (EPDM) rubber.
 2. Materials to have shore hardness from 55 to 60.
 3. Granules shall have a specific density of 1.6 +/- 0.08.
 4. Sulphur cured rubber is unacceptable.
 5. EPDM Granulate shall be Melos GmbH, Gezolan Ag, or approved equal.
 6. The structural spray coat EPDM rubber granules and single component polyurethane shall be pigmented red.

2.4 TRACK & FIELD EVENT SURFACING PHYSICAL PROPERTIES OF SYSTEM

- A. The new synthetic track surfacing system shall exhibit the following minimum performance standards as required by IAAF:

Thickness	≥ 13mm
Force Reduction	35 to 50%
Modified Vertical Deformation	0.6 to 1.8mm
Friction	≥ 47 TRRL Skid Resistance
Tensile Strength	≥ 0.5MPa
Elongation at Break	≥ 40%
- B. The new synthetic track surfacing system shall exhibit the following minimum performance

standards per ASTM:

Tensile Strength (D-412-61T)	300psi
Impact Resilience (D-2632)	0%
Compression Set (D-395-b)	90% - 95%
Compression Modulus (D-575-49):	10% and 50% 8kp/90kp
Gliding Behavior	Wet 0% - Dry 0%
Resistance to oil and normal	Favorable cleaning solutions

2.5 TRACK LINING AND MARKING

- A. The Contractor shall retain a Professional Engineer or surveyor licensed in the State of Washington to layout the track markings. Calculate locations of specified event markings. The calculations shall be made to the nearest 1/10,000th of a foot and angles to the nearest second.
- B. A complete track lining and marking system shall be provided.
- C. All lines and markings are to have true sharp edges with no weeping.
- D. Marking Paint: The paint shall be polyethylene based, specifically manufactured to be compatible with and formulated for application on polyurethane synthetic track surfaces.
- E. Provide layouts in accordance with NFSHSA for the following events:

<u>Event</u>	<u>Notes</u>
100 METER HURDLES	
110 METER HURDLES	
300 METER HURDLES	1 Turn Stagger
400 METER HURDLES	2 Turn Stagger
100 METER DASH	Both directions
200 METER DASH	1 Turn Stagger
400 METER DASH	2 Turn Stagger
800 METER RUN	3 Turn Stagger
1600 METER RUN	Waterfall start
3200 METER RUN	Waterfall start
4 x 100 METER RELAY	2 Turn Stagger
4 x 200 METER RELAY	3 Turn Stagger
4 x 400 METER RELAY	3 Turn Stagger

- F. Other markings shall include:
 - 1. Relay Exchange Zones: Colors as recommended in NFSHSA; solid equilateral triangles with side dimensions equal to clear distance between lane lines at both ends of exchange zone in each lane.
 - 2. Lane Numbers: Five sets of lane numbers "1" through "8", inclusive, with shadowing as approved by the Project Engineer. Separate templates are to be utilized for shadowing. Lane numbers shall be not less than 3" stroke and not less than 24" high.
 - 3. Lane lines shall be white.
 - 4. Long Jump Runways shall be marked at 5 ft. intervals, beginning at the edge of the pit/vault to the end of each runway. Markings shall consist of a 2" equilateral triangle, with a distance from the point of beginning.

PART 3 EXECUTION

3.1 PREPARATION

- A. Accept the track asphaltic base onto which the track and field event rubberized surfacing is to be applied.
- B. Immediately prior to application, all base construction shall be thoroughly cleaned of all dirt,

debris or any other substances that will be detrimental to the installation.

- C. Apply such priming material as may be necessary to assure complete bond of polyurethane to the asphaltic base and adjacent concrete edge surfaces.
- D. Contractor must protect all adjacent areas from any contamination or over spray from rubberized surfacing installation procedures. Tape plastic sheeting to concrete edging or adjacent exposed asphalt concrete paving.

3.2 NOT USED

3.3 TRACK & FIELD EVENT SURFACE INSTALLATION

- A. General:
 - 1. Only experienced, specialized personnel are to be utilized in the installation of surfacing materials and applying the line and marking points. The Superintendent and the supervisory or technical personnel must be employees of the vendor/installer firm.
 - 2. Install in strict accordance with the specifications, drawings, approved shop drawings and manufacturer's specifications and instructions, when applicable.
- B. Environmental Conditions: Materials are not to be placed when:
 - 1. Ambient air temperature is below 50 degrees F.
 - 2. Material temperatures are below 50 degrees F.
 - 3. Surfaces are wet or damp.
 - 4. Precipitation is falling or pending.
 - 5. Conditions exist or are pending that will be unsuitable for the installation of the system.
- C. Equipment: The components shall be blended in a clean and dry, specifically designed, mixing machine with automatic proportioning controls to guarantee exact proportions of the polyols and isocyanates and the auxiliary components (rubber) which control the reactions and balance of the varying climatic conditions during the laying process.
- D. Base Mat Installation:
 - 1. The base layer shall be mechanically mixed to obtain a homogeneous mixture of 20% polyurethane and 80% SBR rubber granulate.
 - 2. Base material to be placed utilizing a mechanically operated finisher with an electrically heated, oscillating finishing screed bar. The base layer shall be placed with a minimum finished thickness of 12mm.
- E. Structural Spray Coat Installation:
 - 1. Contractor must protect all adjacent areas from any contamination or over spray from rubberized surfacing installation procedures. Tape plastic sheeting to edging or adjacent exposed paving to protect synthetic turf and adjacent areas.
 - 2. The structural spray coat top layer shall be mechanically mixed to obtain a pigmented homogeneous mixture of 40% EPDM rubber and 60% urethane. The top layer shall be applied in two uniform applications of a minimum thickness of 1.50 mm.
- F. The completed surface of the track and field events shall be of uniform texture and grade, and be free from defects of any kind.
- G. The finished rubberized track and field event surfacing shall not vary more than +3.0mm and -0.0 mm in 3 meters, measured in any direction as gauged from a straight edge. No reverse slopes or depressions will be allowed. The completed surface of the track and field events shall be of uniform texture and grade, and be free from defects of any kind. There shall be no abrupt "step" deviations greater than 1mm in any area or seam.
- H. Contractor must protect all adjacent areas from any contamination from track installation procedures. Discoloring of any surfaces will be cause for required replacement if cleaning is deemed unacceptable by the Engineer.

3.4 CLEANING

- A. Remove all excess materials of all kinds, equipment, and debris from the site immediately after completion of the work.
- B. Remove all paint splatters, spots, stains, and other blemishes from all finished surfaces. Rubberized surfaces must have a new, uniform appearance.
- C. Leave work in clean condition ready for use by the Owner.

3.5 PROTECTION

- A. Adequate protection from damage of materials and work will be the responsibility of the installer during installation and until acceptance of their work. The Contractor will be responsible for protection after the acceptance of the work until Substantial Completion.
- B. All damaged material prior to, during and after installation shall be replaced at no cost to the Owner.

END OF SECTION

SECTION 32 18 24 SYNTHETIC TURF SURFACING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Track Infield / Athletic Field Scope of work to include all labor, material, equipment, transportation and services to install complete new, vertically draining, in-filled 2.5" monofilament synthetic turf surfacing system for the track infield area / football-soccer field. Infilled Synthetic Turf System to be as herein specified including, but not specifically limited to the following:
1. Independent testing of synthetic turf materials prior to shipment to project site.
 2. Delivery of the synthetic turf materials (not including infill) a minimum of 1 week prior to the scheduled installation of the materials;
 3. Installation of complete vertically draining synthetic turf surfacing system. Field system shall consist of a sand and rubber infill composition.
 4. Installation of monofilament turf system for the field.
 5. Installation of all inlaid or tufted (as applicable) field lines and markings as indicated on the drawings, including alternating contrasting Green panels and field surround, and number shadows.
 6. Supply and installation of all required infill materials (as awarded) and final grooming.
 7. Provide extra turf materials to the Owner for future repair and protective purposes.
 8. Provide all appropriate maintenance manuals, repair manuals, and warranty package to Owner. Warranty shall include a pre-paid insurance policy in support of the warranty required for the field, for the entire warranty period from an A-rated domestic insurance carrier.
 9. Complete specific maintenance activities at specified intervals after the date of acceptance.
- B. Proprietary Specification: In an effort to establish consistency in M&O practices, service requirements and record keeping, the Richland School District has standardized their specification for athletic field synthetic turf surfacing to FieldTurf XM7-65 40oz/sy polyethylene monofilament with sand and SBR crumb rubber infill.

1.02 SYNTHETIC TURF SURFACING PERFORMANCE & PAYMENT BOND

- A. The Synthetic Turf Contractor shall provide a performance and payment bond to the General Contractor for the full subcontract amount of the synthetic turf surfacing system. A copy of the performance and payment bond must be provided to the Owner within 14 days of the issuance of the notice to proceed.
- B. The performance and payment bond must be provided in the name of the same corporate entity that provides the warranty for the synthetic turf surfacing system to the Owner.

1.03 SYNTHETIC TURF SURFACING

- A. The following vendors are pre-approved for the Synthetic Turf Field Surfacing:

1. FieldTurf
- B. Substitution Requests for Synthetic Turf and Synthetic Turf components will not be processed prior to Award of the Contract. Refer to 01 63 00 Products and Substitutions for associated requirements.
- C. All Bidders shall submit the following information within 48 hours of the Bid Opening if requested by the Owner;
1. Vendor Background and Experience: Describe your firm's history. Include information identifying the firm's annual volume and the firm's stability in the marketplace. Also include the firm's record relating to installation schedules and performance.
 2. Provide information regarding local representation, and post-installation support.
 3. Provide proof of bondability.
 4. Product Manufacturer Background and Experience: Describe the history and experience of the product manufacturer with this specific product including years of experience and a count and listing of North American and worldwide synthetic turf field installations. The list shall include field locations, client, client contact names, address, telephone, material installed, date of installation, and general contractor (if any).
 5. Product Installer Background and Experience: Describe the history and experience of the product installer with this specific product including years of experience and a count and listing of field installations. The list shall include field locations, client, client contact names, address, telephone, material installed, date of installation, and general contractor (if any). If the installer is not the manufacturer or vendor of the product, describe the experience the installer has with this specific product.
 6. Product Samples: Provide the following samples with the substitution request.
Two 8"x 12" samples each of green turf without infill material showing backing with perforations.
Two 8" x 12" samples each of turf with the infill material.
Two samples of the proposed in-fill material.
 7. Product Specification: Provide specification for the proposed synthetic turf product. Note any required deviations from the In-filled Synthetic Turf Technical Specifications included in this section.
 8. Product Performance: The samples submitted with the proposal will be reviewed and evaluated. As a supplement to the samples, provide a written description of the following performance criteria for the proposed synthetic turf surfacing system:
 - a. Abrasive characteristics
 - b. Weekly, Monthly, and Annual Maintenance Requirements
 - c. Playability for Soccer
 - d. Wet and Dry Traction
 9. References: Supply a minimum of ten references, including contact name and telephone number, for other installations of this product.

1.04 APPROVED FIBER MANUFACTURERS

- A. The following fiber manufacturers are pre-approved for use in the specified In-filled Synthetic Turf Systems:
1. FieldTurf

- B. The synthetic turf vendor shall provide written documentation in the form of a signed affidavit certifying the source of the fiber used for the field including both green and any other colors used for the lines and markings.
- C. Fiber shall be certified to have less than 50 ppm or less of lead from both the fiber supplier and the turf vendor.

1.05 MINIMUM QUALIFICATIONS FOR SYNTHETIC TURF SYSTEM

- A. Definitions: for the purposes of defining the necessary qualifications required to perform this work, the following definitions will apply.
 - 1. "Infilled Synthetic Turf" refers to surfacing systems comprised of polyethylene fibers no less than 2.25" in finished height, tufted into a coated polyethylene backing, filled with loose, resilient fills to within 1" of the fiber tops.
 - 2. "Full sized" shall mean a single installation of no less than 75,000 contiguous square feet. Large contiguous installations will be considered as a single installation regardless of total square footage.
 - 3. "Successful" in the context of this specification shall be defined as having had zero *repeat* customer call-backs for defects of manufacturing for the life of the warranty or craftsmanship for the first two years.
- B. Approved Synthetic Turf System shall be manufactured, sold, and warranted by a single vendor. Manufacture of the system shall include, at a minimum, assembly of the constituent components, i.e. tufting, of the specified fiber into an approved backing.
- C. The manufacturer of the synthetic turf system must have produced a minimum of twenty (20) successful in-filled synthetic turf soccer fields of full size and outdoors within the past two (2) years. Also, the manufacturer of the synthetic turf system must have produced a minimum of ten (10) successful in-filled synthetic turf full size football or soccer fields with the identical product including infill composition to that proposed for this project within the past year.
- D. Installer of the synthetic turf system must have installed either a minimum of ten (10) successful in-filled synthetic turf football or soccer fields of full size within the past two (2) years or a minimum of twenty (20) successful in-filled synthetic turf football or soccer fields of full size within the past five (5) years. The installer shall have installed a minimum of five (5) successful in-filled synthetic turf football or soccer fields of full size with the product vendor.
- E. The synthetic turf surfacing system vendor shall have a designated employed representative available for service based in the Pacific Northwest (Northern California, Oregon, Washington, Idaho).

1.06 RELATED WORK SPECIFIED IN OTHER SECTIONS

11 68 24	Equipment & Furnishings
32 13 13	Site Concrete Work
33 46 16	Subsurface Drainage
33 46 23	Permeable Aggregate

1.07 STANDARD SPECIFICATIONS

- A. Comply with NFHS Soccer & Football, latest edition, for all field markings.
- B. For standards: Applicable American Society for Testing Materials (ASTM), (latest edition).

1.08 POST AWARD SUBMITTALS

- A. Shop Drawings: Within 14 calendar days after issuance of Notice to Proceed, submit to the Project Engineer five (5) copies of complete and detailed drawings showing all component parts of the synthetic turf system to the Engineer for review. The shop drawings shall be drawn to scale (1"=30' minimum) and shall include:
 - 1. edging details
 - 2. insert details including backing material
 - 3. seam details
 - 4. seam layout
 - 5. gluing patterns
 - 6. dimensional shop drawing for all field lines, markings and boundaries
- B. Synthetic Turf Samples: Within 14 calendar days after issuance of Notice to Proceed, submit to Project Engineer:
 - 1. Two 6"x 12" samples each of green turf showing backing with perforations.
 - 2. Two 6" x 12" samples each of turf showing method of seam makeup with perforations. One sample to have example of inlaid lines.
 - 3. Two 6" x 12" samples each of the other colors proposed for use on the field for lines and markings.
 - 4. Two 1-pound samples of the proposed In-fill material.
- C. Manufacturer's Specifications and Warranty:
 - 1. Within 14 calendar days after issuance of Notice to Proceed, submit to Project Engineer five (5) copies each of selected manufacturer's material specifications and installation instructions. Include detailed specifications of manufacturer's provisions for achieving permeability, stating rate in infiltration and permeability in inches per hour of system materials for the vertical draining system.
 - 2. Within 28 calendar days after issuance of Notice to Proceed, submit to Project Engineer five (5) sample copies of warranty package herein specified for review.
- D. Testing and Quality Control: Within 14 calendar days after issuance of Notice to Proceed, submit the following test results for the system specified to the Engineer. An independent testing laboratory experience with testing of synthetic turf or carpeting materials shall certify these tests. The qualifications of the testing laboratory to be utilized for the submittal and the pre-shipment testing shall be submitted to the Engineer for approval.

Applicable minimum material ASTM tests:

- 1. Dynamic Cushion Test - ASTM F355, Procedure A, (system); ASTM F355 procedure A at the 24" drop.
- 2. Yarn and fabric characteristics plus pad composition and performance.
- 3. Pill Burn Test – ASTM D2859

E. Maintenance and Operating Data:

1. Prior to Substantial Completion, furnish five (5) copies in hard cover form of maintenance and operating data with imprinted Project, Owner, Engineer, Turf Contractor and Turf Subcontractor names, and date of turf system installation.
2. In addition, provide descriptions of any equipment recommended for maintenance and repair, citing specific vendors for each unit.
3. Use and Limitations - Provide a separate page stating approved activity usage for the turf and activities not recommended relative to warranty.
4. Index - Index with tab dividers for data as follows: Materials installed with their characteristics; General maintenance; Small repair procedures; Minor seam repair; Discussion of precautions to be practiced, general maintenance, and uses to avoid to protect turf surface and to maintain installation's warranty.
5. Index - Index with tab dividers for data as follows: Materials installed with their characteristics:
 - a. General maintenance
 - b. Small repair procedures
 - c. Minor seam repair
 - d. Discussion of precautions to be practiced, general maintenance, and uses to avoid to protect turf surface and to maintain installation's warranty
 - e. Recommendations for paint application and removal of lines and markings
 - f. Recommendations for snow removal procedures.

1.09 PRE-SHIPMENT SUBMITTALS

- A. Prior to shipment of the synthetic turf materials to the job site, synthetic turf material from every sixth roll shall be randomly sampled and the tested by an independent testing laboratory experienced with testing synthetic turf materials. The testing laboratory shall be completely independent with no ties to the turf manufacturer. The testing shall include the following:

Item	ASTM	Property
1.	D5848	Pile Weight
2.	D5848	Total Weight
3.	D5823	Pile Height
4.	D5848	Primary Backing Weight
5.	D5848	Secondary Backing Weight
6.	D5793	Backing Perforation Diameter and Spacing
7.	D1335	Tuft Bind (without infill)
8.	D5304	Grab/Tear Strength
9.	-	SBR Rubber Infill Weight
10.	-	Sand Infill Weight

- B. Copies of the test results shall be transmitted to the Owner and Engineer directly from the testing laboratory. The synthetic turf materials shall not be shipped to the site without written authorization from the Engineer after the Owner and Engineer have approved the test results.
- C. Samples of the synthetic turf material tested from every sixth roll shall also be transmitted to the Engineer for approval by the independent testing laboratory prior to shipment of the synthetic turf materials to the job site. Sample size shall be minimum 12" x 12".

- D. All fees and costs associated with the pre-shipment sampling and testing shall be paid by the Contractor.

1.10 CERTIFICATION OF THE BASE

- A. The Synthetic Turf Surfacing Contractor shall furnish to the Engineer, prior to the synthetic turf installation, a written certification of the acceptability by the turf vendor of the prepared aggregate base for installation and warranty validation.

1.11 TURF SYSTEM HOLD HARMLESS

- A. The synthetic turf manufacturer and installer shall not infringe upon any current or pending patents held by other synthetic turf manufacturers or installers.
- B. The Contractor, their synthetic turf subcontractor, and the synthetic turf manufacturer shall hold the Owner, Owner's Representative, the Engineer and their sub-consultants harmless from infringement of any current or future patent issued for the synthetic turf surfacing system, installation methods and vertical draining characteristics. A notarized statement shall be provided as part of the submittal package.

1.12 WARRANTY OF SYNTHETIC TURF

- A. Warranty shall cover, in general, the usability of the turf surface, accessories, use characteristics, and suitability of the installation. All items covered by warranty are to be replaced or repaired with new materials, including installation at the sole expense of the warranting contractor for the period of eight (8) years to the Owner, for the designated uses enumerated as follows:
 - 1. Football
 - 2. Soccer
 - 3. Lacrosse
 - 4. Physical exercises
 - 5. Various physical education curriculum activities
 - 6. Entertainment & Ceremonial activities
 - 7. Pneumatic rubber-tired maintenance and service vehicles
 - 8. Pedestrian traffic and other similar uses
- B. A principal of the applicable firm, duly-authorized to make contracts, shall sign the turf vendor warranty. If the turf vendor is not the manufacturer, the manufacturing firm shall also sign the warranty. The term "Contractor" contained herein means the firm furnishing warranty. "Owner" is the Richland (WA) School District.

Warranty period shall be a minimum of eight years from date of acceptance of the installed system by the Owner.
- C. Furnish a pre-paid insurance policy in support of the warranty required for the field, for the entire warranty period from an A-rated domestic insurance carrier. The warranty shall be secured to the Owner with an insurance policy of not less than \$300,000 per claim and an aggregate of \$5,000,000.

1.13 FORM OF WARRANTY OF SYNTHETIC TURF SYSTEM

- A. Contractor hereby warrants to Owner, subject to the limitations and conditions set forth below, that its synthetic turf system consisting of synthetic turf described as (Product

Trade Name) and the adhesives used in the installation, is free from defects in material and workmanship and shall, for a period of eight years as applicable from the date of Substantial Completion, remain serviceable for multiple sports activities."

- B. Contractor warrants to the Owner that its synthetic turf materials shall not fade, fail, shrink, wrinkle, or reflect excessive wear. Contractor shall, at their sole expense and cost, replace such areas of the synthetic turf system not performing to these standards for the life of the warranty.
- C. Definitions
 - 1. The term "not fade" in the context of this warranty shall mean that the synthetic turf material shall remain a uniform shade of green, or other colors installed, with no significant loss of color.
 - 2. The term "not fail" or "excessive wear" as used in the context of this warranty shall mean that the length and weight of the face yarn or pile material in the synthetic turf surface shall not have been decreased by more than 10% per year according to ASTM D418, nor exceed 50% during the warranty period. In the event that the synthetic turf system does not retain its fiber height or shock absorbency and is consequently no longer serviceable during the warranty period, the Contractor shall, at their sole expense, replace such portion of the system that is no longer serviceable.
 - 3. The term "serviceable" in the context of this warranty shall mean that the synthetic turf system shall have a maximum "G" value according to ASTM F1936-10 and Procedure A, ASTM F355, not to exceed 135G's at any location upon installation and shall not exceed 160G's throughout life of the warranty period. This shall be determined by conducting dynamic cushioning tests at the locations designated in ASTM F1936-10 and at corners of the soccer penalty boxes at opposite sides of the field. Any increase from 135G's to allowable 160G's maximum shall be at a relative uniform rate not to exceed 15 G's in any single yearly period.
- D. Where applicable, the fabric seams shall remain attached to the underlying surface over the warranty period and shall not separate or become unglued or unattached, as applicable.
- E. Contractor warrants to the Owner that the permeable synthetic system shall drain vertically a minimum of 20 inches precipitation per hour without visible surface ponding.
- F. Contractor shall replace with new materials, at their sole expense, any damage to the synthetic turf system that extends more than 3 feet beyond the location of foreign combustibles, which may ignite and fire-damage the synthetic turf system. The Contractor shall not be held liable for any incidental or consequential damages. These warranties and the Contractor's obligations here-under are expressly conditioned upon;
 - 1. The Owner making all minor repairs to the synthetic turf system upon the discovery of the need for such repairs;
 - 2. The Owner maintaining and properly caring for the synthetic turf system in accordance with the Contractor's maintenance manual and instructions;
 - 3. The Owner complying with the dynamic and static load specifications established by the Contractor.
- G. The warranty is not to cover any defect, failure, damage or undue wear in or to the synthetic turf system caused by or connected with abuse, neglect, deliberate acts, act of God, casualty, static or dynamic loads exceeding Contractor's recommendations,

footwear having metal cleats, spikes, or similar projections other than conventional baseball, football, soccer, or rugby shoes having cleats of not more than 1/2" in length, and other conventional running track shoes having spikes of not more than 1/4" in length, or use of improper cleaning methods.

- H. Contractor shall be allowed to examine the synthetic turf system regarding any claim that the Owner makes to be present at any time, to analyze the results of all tests conducted by the Owner or others, and to conduct such tests of their own. Contractor shall not be responsible for any costs or expenses incurred by the Owner or others with respect to such tests, except the Contractor shall pay for costs of all tests and analysis conducted or directed by their representative.
- I. In the event the Contractor does not respond to the Owner's written notice within 10 days of receipt of notice or does not submit, schedule and execute corrective work within 30 days, the Owner has the option of having the work performed at the expense of the Contractor.
- J. Sample form of warranty herein set forth is a suggested form for use for the work under this section. Manufacturer's standard form of warranty may be used provided all conditions specified are incorporated. All claims by the Owner under this warranty must be made in writing to Contractor's address at _____ within 30 days after the Owner learns of the defect giving rise to the claim. This warranty shall constitute a contract made in the State of Washington and shall be governed by the laws thereof.

1.14 WARRANTY TESTING

- A. The turf for the field is to be tested for dynamic cushioning ("GMAX" Test) by an experienced independent testing laboratory acceptable to the Engineer or Owner at the completion of the installation shortly prior to acceptance inspection by the Owner/Engineer, at the anniversary date of the first year, second year, fourth year, sixth year, and 60 days prior to the anniversary date of the warranty expiration. If conditions of the Specifications and/or Warranty are not met, the Contractor has the option of corrective work or replacement. In the event corrective work does not meet the requirements of the Specifications after a second attempt to bring the system within these limits, then the Contractor is to replace non-conforming areas or sections solely at the Owner's discretion and direction.
- B. Tests shall be performed in accordance with ASTM F-1936-10 and F355 10A.
- C. Test locations as designated in F-1936-10, Paragraph 8. Included in the report shall be the measured depth of the infill material at all test locations.
- D. All costs for the stated testing shall be paid by the Synthetic Turf Surfacing Contractor.
- E. If the Contractor does not have the tests performed within 10 days of specified times listed, the Owner has the option of ordering the testing work at the expense of the Synthetic Turf Surfacing Contractor.

PART 2 - MATERIALS

2.01 GENERAL

- A. Infilled Synthetic Turf: The turf system shall be a vertical-draining permeable synthetic

turf system. The turf system shall consist of a synthetic grass like surface pile, which shall be tufted into a synthetic backing.

- B. All backing layers and coatings shall be firmly bonded together. Coating materials must be completely cured and bonded to the other backing layers. Synthetic turf panels or rolls that do not meet this requirement will be rejected.
- C. The entire system shall be resistant to weather, insects, rot, mildew, and fungus growth, and be non-allergenic and non-toxic. The entire system shall be constructed to maximize dimensional stability, to resist damage and normal wear and tear from its designated use, and to minimize ultraviolet degradation.
- D. All adhesives used in bonding the system together shall be resistant to moisture, bacterial and fungus attacks, and resistant to ultraviolet rays at any location upon installation.

2.02 DYNAMIC CUSHIONING REQUIREMENTS

- A. The dynamic cushioning of the system shall not exceed a maximum value of 135 G's per ASTM, F1936-10 and ASTM, F355, procedure A at any location upon installation.

2.03 PERMEABILITY REQUIREMENTS OF THE SYNTHETIC TURF SYSTEM

- A. The system including the synthetic turf, infill materials, and supplemental pad (if applicable) shall drain vertically a minimum of 20 inches precipitation per hour without visible surface ponding.

2.04 SYNTHETIC TURF PILE SURFACE

- A. The pile surface shall provide good traction in all types of weather with the use of conventional "sneaker-type shoes" and composition, molded-sole athletic shoes.
- B. The pile surface shall be suitable for both temporary and permanent line markings using rubber-base paint where applicable.
- C. Pile surface shall be nominally uniform in length for all portions of the field. Synthetic turf panels or rolls with irregular pile heights or with "J hooked" fibers that extend more than 1/4 inch above the surrounding fibers will be rejected.

2.05 SYNTHETIC TURF FABRIC SURFACE

- A. The fabric surface shall be constructed and installed in minimum 15-foot widths with no longitudinal or transverse seams, except for head or tee seams at field boundaries and inlaid lines within a finished roll assembly. The seams shall be 15'-0" spacing.
- B. Rolls that do not lay evenly and with full dimension width will be rejected. No fitted pieces will be allowed to true alignment.
- C. The color shall be uniform with no visible deviations in shade permitted. Rolls that do not meet this requirement will be rejected.

2.06 SYNTHETIC TURF SYSTEM MATERIAL COMPONENTS

- A. Pile fibers shall resemble freshly-grown natural grass in appearance, texture and colors.

- B. Fabric backing for the in-filled synthetic turf systems can be loose laid and anchored at the perimeter of the fields as shown in the details or adhered to the base.
- C. All turf seams shall be constructed per paragraph 3.04 of this section.
- D. No transverse or head seams will be permitted except as shown on the approved Shop Drawings.

2.07 SYNTHETIC TURF PERMEABILITY

- A. Synthetic turf with tufted fibers and a coated backing must include either perforations in the backing for vertical drainage, or the turf shall include a partially coated backing providing permeability without the use of perforations. Certified independent test results indicating a minimum drainage rate of 40 inches per hour for the permeable backing must be provided.
- B. Perforations in turf backing to be a minimum of 3/16" diameter clear opening and shall be spaced a maximum of 4" uniformly on-center.
- C. The turf shall be perforated with a minimum of 95% integrity over entire surface. Holes must be full diameter, completely through the underside of the turf backing with no material residue or fragmented fibers remaining.
- D. Engineer shall approve the turf perforations prior to shipment, upon shipment onsite, or during on-site perforating operations as applicable.
- E. If the non-permeable backing material exceeds 12 inches in width it shall be perforated in accordance with paragraph 2.07 of this section. Perforations shall be drilled from the surface after the adhesive has set.

2.08 FIELD, LINES, AND MARKINGS

- A. Field Body and Surround shall consist of two blended greens, with the field surround and end zones consisting of "Field Green", with alternating 5-yard x60-yd panels of a 50% Lime Green, 50% Field Green blend.
- B. A complete field lining, marking and field boundary system with team area limits, etc., shall be provided with the initial installation of the surfacing system. Layouts shall be accurately surveyed and marked prior to installation.
- C. All lines and field markings shall be tufted in or installed as synthetic turf inlays. Wherever possible, lines shall be tufted into the turf panels in lieu of inlays. All markings shall be uniform in color, providing a sharp contrast with the turf color, and shall have sharp and distinct edges. Markings shall be true and shall not vary more than 7/32" from specified width and location.
- D. Manufacturer shall guarantee the synthetic turf is adaptable to painted lines in the event painting is utilized in the future.
- E. Minimum Lining and Marking Requirements: All lines, numbers and field markings are to be tufted in or installed as synthetic turf inlays without the use of paint.

1. Base Bid

- a. Football Lines: 8" Boundary & Goal Line, 4" White lines
- b. Soccer Lines: 4" Yellow lines
- c. Lacrosse Lines: 4" Medium Blue lines
- d. Numbers White
- e. Shadows Black

2.09 MINIMUM SPECIFICATIONS FOR SYNTHETIC TURF SYSTEM MATERIALS

- A. The minimum material specification requirements will be verified and enforced and will be the basis for Owner's testing. Material that fails to meet these minimum specifications will be rejected. The material specifications in this section are minimums. The manufacturer of the synthetic turf fiber and fabric may elect to exceed these specifications to insure compliance with all requirements and the warranty as specified in this section.
- B. Color of synthetic turf shall be green. Additional turf colors shall be as called for in Section 2.08 for the lines and markings, generally white, yellow, and purple. The fiber used for the lines and markings shall be of the same composition in all respects except for color as that used for the green field areas.

2.10 MINIMUM TURF MATERIAL SPECIFICATIONS

- A. Base Bid Fiber Properties, Track Infield / Football-Soccer Field, and Markings, Monofilament Fiber

<u>ASTM</u>	<u>Property</u>	<u>Minimum Specifications</u>
D1577	Yarn Denier / Ply	12,000
D2256	Yarn Breaking Strength	20 lbs
D2256	Yarn Elongation to Break	50%
D789	Yarn Melting Point	240° F.

- B. Fiber shall be certified to have less than 50 ppm or less of lead from both the fiber supplier and the turf vendor.
- C. Fiber Wear Simulation: Fiber shall exhibit no splitting or appreciable degradation after a minimum of 12,000 cycles of simulated Lisport wear testing and shall remain serviceable without appreciable face weight loss after a minimum of 40,000 cycles of simulated Lisport wear testing.
- D. Fabric Composition: Shall consist of 100% polyethylene yarn tufted into polypropylene backings coated with high-grade polyurethane. Coating and backing materials shall assure suitable tuft bind strength, dimensional stability, and long-term wearing properties.
- E. The following typical description and minimum finished specifications per ASTM F-1551 (Test Method as indicated) shall apply to each required product:
 - 1. Base Bid, Stadium Football/Soccer Field installation product to be a polyethylene monofilament constructed to the following criteria:

FieldTurf XM7-65 2.5"/40 oz. Monofilament Product.

<u>ASTM</u>	<u>Property</u>	<u>Minimum Specification</u>
D418	Pile Weight	40 oz/sq yard
D418	Primary Backing	8 oz/sq yard total

D418	Back Coating	18 oz/sq yard
D418	Total Weight	65 oz/sq yard
D418	Pile Height	2.50 – 2.60"
D5793	Stitch Gauge	3/4"
D1335	Tuft Bind (without infill)	8 lbs.
D1682	Grab/Tear Strength	200 lbs.
D2859	Pill Burn Test	Pass
	Total Infill Ballast Weight	>8 lbs.

2.11 INFILL SYSTEM

- A. The synthetic turf shall utilize a combination of sand and cryogenically rendered crumb rubber infill materials.
- B. The minimum sand content shall be 20% by volume and the maximum sand content shall not exceed 35% by volume. The exact in-fill material ratio may be altered to provide strength, shock attenuation, and to provide permeability by the vendor/installer as approved by the Field Consultant.
- C. Infill material shall be applied in a dried condition when the turf is dry. It shall be applied in uniform layers effectively dragged to distribute the material uniformly to the backing of the turf.
- D. The sand infill material shall be graded silica sand, sub-round to round, compaction resistant, washed and dried. The sand shall meet the following criteria:

1.	Percent Silica	80%-95%
2.	Shape	Round to Sub-round
3.	Sphericity	0.65 – 0.85
4.	Roundness	0.60 – 0.70
5.	Hardness (Moh)	7

- E. The sand gradation shall meet the following wet sieve analysis:

<u>Sieve Size</u>	<u>Percent Retained</u>
#16	0% – 5%
#20	10% – 20%
#30	50% – 70%
#40	15% – 25%
#50	0% – 10%
#100	0% – 5%
Pan	0% – 2%

- F. Rubber shall be SBR free of any tire cord, steel materials, and kevlar. Only automotive or truck tires manufactured in North America within the last 10 years may be used for the SBR infill material. The infill material gradation shall meet the following size requirements:

2.0 – 1.5 mm	0% - 10%
1.5 – 1.0 mm	10% - 30%
1.0 – 0.5 mm	40% - 80%
0.5 – 0.0 mm	0% - 10%

- G. SBR rubber shall be certified to have less than 50 ppm or less of lead from both the

rubber supplier and the turf vendor.

- H. Maximum exposed fiber height shall be $\frac{3}{4}$ " after infill placement, settling, and compaction.

2.12 MAINTENANCE EQUIPMENT

- A. Primary Grooming equipment to be a static, tow-behind unit with continuous stiff nylon bristles extending to no less than 9' in effective width for leveling infill and grooming fiber, and shall have a manually adjustable set of steel tines for de-compaction.

Manufacturers Reference:
GreensGroomer "920SDE"
FieldTurf "GroomRight"
SMG "DC1600"

- B. Debris removal – Contractor shall provide towable lawn sweeper units with perforated basket base suitable for synthetic turf use in removal of litter and leaf debris. Total effective width of operation (per pass) to be no less than 7' when towed in combination.

PART 3 - EXECUTION

3.01 CERTIFICATION OF FIELD BASE INSTALLATION

- A. The Contractor shall perform an inspection of the prepared permeable aggregate base or elastic layer system, and submit written certification of acceptance of the base for the installation of the synthetic turf system.
- B. Summary of certification shall include, but not be limited to:
 - 1. Acceptance of the base construction "finish surfaces" as totally suitable for the application of work specified under this section.
 - 2. Verification and certification of the infiltration and permeability rates as applying to the warranty.
- C. All discrepancies between the required materials, application and tolerance requirements noted by the turf installer shall be brought immediately to the attention of the Contractor, Engineer and Owner. Failure of the turf installer to immediately inform the Contractor, Engineer, and Owner of any prior work that does not meet the required specifications will result in the turf installer being required to perform any work needed to bring the base to acceptable condition.

3.02 INSPECTION OF MATERIALS

- A. Prior to installation, and immediately upon delivery of synthetic turf system materials to the project site, the Contractor shall inspect material as follows:
 - 1. For damaged or defective items;
 - 2. Measure turf pile height and thickness of each roll;
 - 3. Measure backing perforation diameter and spacing;
 - 4. Reject damaged materials and all materials out of tolerance with this specification.

- B. After installation, inspect project area for acceptable seaming, adhesive bonding, uniformity of color of turf, bubble-free surface smoothness as laid, field lines and markings, insert installations, edge details. Remove and/or repair deficient workmanship prior to requesting the Engineer's inspection pursuant to completion and acceptance of the work.

3.03 OWNER'S TEST

- A. Owner may have samples of the turf submitted and tested for verification of conformance to specifications. Turf system acceptance is subject to the results of these tests.
- B. Any material so tested and found not conforming to specification will be rejected and replaced with material conforming to the specification at Synthetic Turf Surfacing Contractor's expense. Re-submittal will be required.

3.04 SYNTHETIC TURF INSTALLATION

- A. Perform all work in strict accordance to the drawings, specifications, shop drawings and manufacturer's specifications and instructions.
- B. Verification: The Contractor is responsible for inspecting, verifying, and accepting all installed work of this section.
- C. Environmental Conditions: Do not apply adhesive materials or infill material when:
 - 1. Ambient air temperature is below 40 degrees F.
 - 2. Material temperatures are below 40 degrees F.
 - 3. Rain is falling or pending
 - 4. Conditions exist, or are pending, that will be unsuitable to the installation of the system.
- D. Preparation:
 - 1. Accept base onto which the synthetic turf surfacing system and the anchoring system are to be applied, as specified above.
 - 2. Immediately prior to application of the synthetic turf, the base shall be thoroughly cleaned of all foreign material, soil, or any other substances that may be detrimental to permeability and the installation of the turf system.
- E. Equipment and Access:
 - 1. Passenger vehicles shall not be allowed to park or staged upon the completed aggregate surface either prior to or during installation of the synthetic turf.
 - 2. Equipment utilized during construction including compressors, generators, etc. shall be in complete working order, with exhaust systems oriented vertically and away from the synthetic turf surface. At any location where equipment is parked and/or staged on the turf surface during installation, adequate protection of the finish turf surface will be required including, but not limited to heat resistant panels to ensure 100% viability of the finish turf surface and fibers. Should a portion of the turf be damaged as a result of installation techniques, the entire turf panel may be subject to rejection and replacement at the direction of the Engineer.

- F. The fabric surface shall be constructed and installed in 15 -foot minimum widths with no longitudinal or transverse seams, except for head or tee seams at field boundaries and inlaid lines within a finished roll assembly.
- G. No head seams shall be permitted inside of the Football field boundaries. A single head seam will be permitted in the quarter turned panels within the soccer sidelines.
- H. Rolls that do not lay evenly and with full dimension width will be rejected. No fitted pieces will be allowed to true alignment. No fitted pieces or cutting within the panels will be allowed to provide true alignment or to eliminate wrinkles.
- I. Bonding of Material Surfaces: The bonding or fastening of all system material components shall provide a permanent, tight, secure and hazard-free, athletic playing surface. System material components include:
 - 1. Bonding all seams and inlaid line and markings
 - 2. Bonding and seaming must maintain their integrity for total length of warranty period.
- J. Seams (Joint)
 - 1. All turf panel seams within the field grid and the ¼ turn sideline panels shall be sewn with high strength cord.
 - 2. All other seams shall be cemented with a supplemental backing material.
 - 3. The seam gaps between fiber rows at the seam locations shall not exceed that of the tufting gauge of the turf materials.
 - 4. All sewn seams shall be brushed to provide full coverage of fiber over the thread.
- K. Turf Edges: Turf edges to be as shown on the edge fastening detail and nailed at the perimeter.

3.05 SYNTHETIC TURF EDGE ANCHOR INSTALLATION

- A. Anchor synthetic turf along the sides and ends to existing edge anchor as shown in the details.

3.06 LINING / MARKING INSTALLATION

- A. Complete field markings shall be provided with the initial installation of the surfacing system. Provide lines and markings in conformance with these specifications. Layouts shall be accurately surveyed and marked prior to installation.
- B. If overlapping backing materials are utilized for the inlaid lines and markings resulting in a non-permeable surface in excess of 12 inches wide, the backing materials shall be perforated in conformance with section 2.07 after gluing and prior to installation of the infill material.
- C. To the greatest extent practical, lines and markings shall be installed without compromising the primary backing.

3.07 IN-FILL INSTALLATION

- A. The in-fill material shall be applied in a dry condition and when the synthetic turf is dry.

- B. The synthetic turf installer shall not infringe upon any current or pending patents held by other synthetic turf manufacturers or installers with the installation of the in-fill materials.
- C. For sand and rubber infill systems, the infill materials will be installed with a minimum of 8 applications.
- D. The infill installation shall not result in fiber material trapped below the surface of the infill material. If fiber is trapped below the surface, a portion or all of the infill material must be removed and reinstalled.
- E. The infill material shall be installed at a uniform depth across the entire field area. Infill depths shall not vary by more than +/- 5 mm from the design infill level indicated in the approved submittals across the entire synthetic turf surfacing area.
- F. The brushing of the in-fill material shall provide fiber fibrillation resulting in a natural surface appearance. If in Owner's opinion more fibrillation is desired, the Synthetic Turf Contractor shall provide additional brushing of the surface to provide the desired level of fibrillation.
- G. The in-fill materials shall be water settled to provide accelerated consolidation of the in-fill material prior to use by the Owner. Water will be available from quick coupling valves located around the field. The Synthetic Turf Contractor shall utilize the field cooling sprinkler heads to evenly apply a minimum of 1 inch of water over the entire field area for water settlement. Upon completion of the initial water settlement, the surface will be inspected the Owner and Engineer for footing stability and in-fill consolidation. The Synthetic Turf Contractor shall provide any additional water settling as required by the Owner and Engineer to achieve the desired level of in-fill stability and consolidation.

3.08 CLEANING

- A. Remove all excess materials of all types, equipment, debris, etc., from the site immediately after completion of the work. Remove all stains and other blemishes from all finished surfaces. Leave work in clean, new appearing condition, ready for use by Owner.
- B. The Contractor shall inspect the entire field area with a hand held metal detector to identify any construction materials or tools left on the field. All such materials shall be removed prior to Substantial Completion.

3.09 PROTECTION

- A. Adequate protection of materials and work from damage will be the responsibility of the installer during installation and until acceptance of their work. Synthetic Turf Surfacing Contractor will be responsible for protection after acceptance of the work until final acceptance of all contract work by the Owner. All material damaged prior to acceptance by the Owner shall be replaced at no cost to the Owner.

3.10 EXTRA MATERIALS

- A. Deliver to Owner all extra materials herein specified. Receive Owner's written receipt for all materials. Deliver receipt to Owner's Representative.

- B. Infill Materials: Provide four (4) 33 gallon rubber trash containers with lids of each infill material used.
- C. Turf for Future Repairs: Material may be roll ends or cutoffs; however, each piece of fabric shall be at least 5' x 10'. At least one green turf piece shall be at least 10' x 15'. The following are minimum areas for the extra synthetic turf materials to be provided by the Contractor to the Owner:

Minimum Quantities:

- 1. Field Green Turf: 1000 sf
- 2. Lime Green / Field Green Blend 750sf
- 3. White Turf: 200 lf of 4" wide lines
- 4. White Turf: 100sf
- 5. Yellow Turf: 150 lf of 4" wide lines
- 6. Blue Turf: 100lf of 4" wide lines

3.11 MAINTENANCE

- A. Vendor shall complete maintenance of the synthetic turf field at both 6 months and 1 year after the date of Substantial Completion. Minimum maintenance activities shall include:
 - 1. Inspect and repair as required each seam.
 - 2. Inspect and repair each inlay and marking as required.
 - 3. Brush and remove surface debris, loose fibers and any other deleterious material. Use of a rotating, mechanical brush is recommended.
 - 4. Re-level infill materials. Import and place /top dress new infill material matching original infill materials as needed to establish original infill depth, with $\frac{3}{4}$ " of exposed fiber.
- B. All maintenance activities shall be as approved and directed by the original manufacturer.
- C. All maintenance activities shall be coordinated with scheduled use of the facility and completed at the convenience of the owner and applicable user groups.

END OF SECTION 32 18 24

SECTION 32 31 14 CHAIN LINK FENCING & ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Scope Of Work

1. Provide chain link fences, gates, rail cap, and screens as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings completely installed and functioning.
2. All perimeter chain link posts, rails, fabric and hardware shall include a galvanized finish.
3. All track crowd control fence (4' ht.) posts, rails, fabric and hardware shall include a black finish as specified.

B. Related Sections

- 31 20 00 Earth Moving
- 31 22 16 Field & Track Subgrade Establishment
- 32 13 13 Concrete Paving

1.02 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data: Submit the manufacturer's technical data and installation instructions for metal fencing and gates.
- C. Shop Drawings: Submit shop drawings showing elevations and details of assembly.

1.03 MATERIALS STANDARDS

- A. Materials standards shall adhere to Standards for Galvanized Steel Chain Link Fence Fabric, Standards for Industrial Steel Specifications for Fence Posts and Accessories, Standards for chain Link Fence Installation; as published by Chain Link Fence Manufacturer's Institute (CLFMI); American National Standard Institute (ANSI).
 1. Standards for Galvanized Steel Chainlink Fence Fabric
 2. Standards for Industrial Steel Specifications for Fence Posts and Accessories
 3. Standards for Chainlink Fence Installation as published by Chainlink Fence Manufacturer's Institute (CLFMI)
 4. American National Standard Institute (ANSI).

1.04 WELDING

- A. All welding shall be completed by a certified welder.

PART 2 MATERIALS

2.01 GENERAL

- A. Dimensions shown for pipe are outside dimensions.

2.02 STEEL FENCING

- A. Typical Fabric: No. 9 ga. (0.158") finished size steel wires, 2" mesh, with knuckle both top and bottom.
- B. Furnish one-piece fabric widths for all fencing.
- C. Fabric finish: galvanized at perimeter fencing, black fusion-bonded pvc at track crowd control fence.
- D. Framework: steel with galvanized finish at perimeter fencing, black powder coat at track crowd control fence.

- E. Hardware and Accessories: steel with galvanized finish at perimeter fencing, black paint at track crowd control fence.

2.03 COLOR-CLADDING FOR FENCE COMPONENTS

A. Fabric:

1. Standard Woven-wire Fabric, No. 9 ga. (0.148") finished size steel wires, 2" mesh, with knuckle both top and bottom.

B. Furnish one-piece fabric widths for fencing up to 10' high.

C. Fabric finish: Galvanized, ASTM A392, Class I, with not less than 1.2 oz. zinc per sq. ft. (for 2" mesh) of surface with black class 2b PVC fusion bonded coating.

D. Framework: Galvanized steel, ASTM A120 or A123, with not less than 1.8 oz. zinc per sq. ft. of surface with a powder coated black gloss finish.

E. Hardware and Accessories: Galvanized steel, ASTM A120 or A123, with not less than 1.8 oz. zinc per sq. ft. of surface, with a powder coated black gloss finish.

2.04 FRAMING AND ACCESSORIES

The Contractor may, at their option, provide all steel pipe as either Schedule 40 Galvanized or SS40 Galvanized. Where SS40 is the Contractor's option, special consideration may be made for certain pipe sizes to be provided as Schedule 40 Galvanized (generally, posts 20' or over or greater than 4.0" O.D.).

A. End, Corner and Pull Posts: All posts shall be standard steel pipe, straight, true and un-spliced. Minimum sizes and weights as follows:

B. 4' and 6' height, 2.875" o.d. steel pipe, 5.79 lbs. per l.f.

C. Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double-gate installation, for nominal gate widths as follows:

Leaf	Width	Gate Post	Lbs/L.F.
5', 10' & 12' (Clear)	4.000"	o.d. pipe	9.11

D. Line Posts: All posts shall be standard steel pipe, straight, true and up to 20 ft. length to be unspliced. Minimum sizes and weights as follows:

1. Space 10' o.c. maximum, unless otherwise indicated.
2. 4' and 6' fabric height, 2.375" o.d. steel pipe, 3.65 lbs. per l.f.

E. Top, Bottom and Intermediate Rails: Manufacturer's longest lengths, with expansion type couplings, approximately 6" long, for each joint. Provide means for attaching top rail securely to each gate corner, pull and end post. Rails shall be 1.66 o.d. pipe, 2.27 lbs. per l.f.

F. Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener.

G. Post Tops: Weather-tight closure cap (for tubular posts), one cap for each post. Furnish caps with openings to permit passage of top rail.

H. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross-section of 3/15" x 3/4". Provide one stretcher bar for each gate and end post, and two for each corner and pull post.

I. Stretcher Bar Bands: Space not over 15" o.c., to secure stretcher bars to end, corner, pull, and gate-posts. Provide offset type bar bands at backstop posts so that fabric is aligned with inside edge of posts.

J. Tension Wire: Shall be marcelled (spiraled or crimped) #7 gauge, 0.177 inches in diameter, conforming to ASTM A-824. Finish to be galvanized to match fabric.

- K. Wire Ties: For tying fabric to line posts, use wire ties spaced 18" o.c. For tying fabric to rails and braces, use wire ties spaced maximum 18" o.c.

2.05 GATES

- A. Gate Posts: Furnish 4.0" o.d. posts, 9.11 lbs/lf, for supporting a single gate leaf of nominal 5', 7', 10' or 12' lengths.
- B. Fabricate swing gate perimeter frames of minimum 1-5/8" o.d. pipe. Metal and finish to match framework. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.
- C. Assemble gate frames by welding or with special fittings and rivets, for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical and top and bottom edges. Attach stretchers to gate frames at not more than 15" o. c. Attach hardware to provide security against removal or breakage. Install diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist, as required.
- D. Rolling Gates; Provide rolling gates and cantilevered gates as shown.

2.06 GATE HARDWARE

- A. Swing Gates; Furnish the following hardware and accessories for each gate.
 - 1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180° gate opening.
 - 2. Latch: Rollo-type locking latch, galvanized.
 - 3. Gate-stops: Provide gate stops at open and closed gate positions, for double leaf gates and at open position for single leaf gates, except for batting cage gates. Gate stops shall be mushroom type of flush plate with anchors. Set stop in concrete, to engage drop rod or plunger bar.
- B. Rolling Gates: Wheel core and hub, roller guides, and roller guide rails shall remain uncoated galvanized steel (no coatings).

PART 3 INSTALLATION

3.01 CHAIN LINK FENCE INSTALLATION

- A. Excavation: Drill holes for posts of diameters shown in firm, undisturbed or compacted soil. Excavate holes to minimum diameter and depth as shown on the drawings. Excavate hole depths approximately 4" lower than post bottom. Refer to drawings for depth.
- B. Setting Posts: Center and align posts in holes 4" above bottom of excavation. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. No concrete or concrete grout is to extend beyond limits of footing hole.
- C. Top Rails: Run rail continuously through post caps, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.
- D. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- E. Fabric: Leave approximately 1" between finish grade and bottom selvage. Fabric to be installed so that the baseballs cannot roll underneath the fabric. Pull fabric taut and tie to posts and rails. Install fabric on the field side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- F. Stretcher Bars: Thread through or clamp to fabric 4" o.c., and secure to posts with metal bands spaced 14" o.c. maximum. Align off set type stretcher bar bands to allow fabric to align with field side of posts. A maximum of 1/2" displacement will be allowed.

- G. Tension Wire: Shall be stretched from end to end of each stretch of fence where indicated on drawings and details. The tension wire shall be taut and free of sag.
- H. Tie Wires: Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend wire to minimize hazard to persons or clothing.
- I. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.02 GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference. The clear opening shall be equal to or larger than the size specified on the drawings. Install ground-set items in concrete for anchorage, as recommended by fence and turnstile manufacturer. Adjust hardware for smooth operation and lubricate where necessary.

END OF SECTION

SECTION 32 84 00 - LANDSCAPE IRRIGATION

PART 1-GENERAL

1.1 SUMMARY

- A. Section Includes Base Bid as indicated in project drawings.
 - 1. Pipe and fittings, valves, sprinkler heads, accessories, and connections to water source.
 - 2. Control system.
 - 3. Flow Meter.
 - 4. Pump and Filter Assembly
- B. System Description
 - 1. Two-wire electric solenoid automatic underground irrigation system.
- C. Related Sections
 - 1. Division 26 Sections for electrical power materials and installations.
 - 2. Division 32 Sections for Landscape Grading, Turf and Grasses and Plants.
 - 3. Division 33 Sections for Civil Water Supply.

1.2 DEFINITIONS

- A. Pipe sizes used in this Section are nominal pipe size (NPS) in inches. Tube sizes are Standard size in inches.
- B. Pressure Piping Main Line: Piping downstream from supply piping to and including control valves. Piping is under irrigation system pressure. Piping in this category includes backflow preventers.
- C. Circuit Piping Lateral Lines: Piping downstream from control valves to irrigation system sprinklers. Piping is under pressure (less than pressure piping) during flow.
- D. Control Valve: Automatic (electrically operated) valve for control water flow to irrigation system zone.
- E. Point-of-Connection: Location where the Contractor shall tie into the water supply for landscape irrigation needs and use. Tie to existing piping.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Location of Sprinklers and Devices: Contractor shall prepare an irrigation layout plan showing irrigation piping main and laterals, valving and sprinkler heads for the project area.
- B. Minimum Head to Head Water Coverage – not less than:
 - 1. Turf Areas: 100 percent.
 - 2. Other Planting Areas: 100 percent.
- C. All flow velocities, within the entire irrigation system, shall not exceed 5 feet per second.

1.4 SUBMITTALS

- A. A detailed irrigation layout plan showing irrigation piping main and laterals, valving and sprinkler heads for the project area. Irrigation plan shall be reviewed by the Owner's representative. No work shall commence on the irrigation system until the irrigation plan has been accepted.
- B. Product data including pressure rating, rated capacity, settings, and electrical data of selected models for the following:
 - 1. Valves, including general duty, underground, automatic control, quick-coupler, and isolation types, valve boxes and valve ID tags.
 - 2. Sprinklers.
 - 3. Controls, including controller wiring diagrams.
 - 4. Wiring.
 - 5. Irrigation system record drawings.
 - 6. Flow meter
 - 7. Pipe, fittings, etc.

8. Concrete Vaults and Lids.
 - B. Wiring diagrams for electrical controllers, valves, and devices. Valve numbers shall reflect station numbers within the controller and shall be noted on the as-built drawings.
 - C. Maintenance data for inclusion in "Operating and Maintenance Manual" specified in Division 1 Section "Contract Closeout" for the following:
 1. Seasonal activities of start-up, shut-down and winterization, including blow-out operation of sprinkler system with compressed air.
 2. Automatic control valves.
 3. Sprinklers.
 4. Controllers.
 5. Irrigation system record drawings.
 6. Flow Meter.
- 1.5 QUALITY ASSURANCE
- A. Comply with requirements of utility supplying water for prevention of backflow and backsiphonage. Comply with appropriated water rights.
 - B. Installer Qualifications: Engage an experienced Installer with a minimum of five years of experience and who has completed irrigation systems similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
 - C. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.
 - D. Listing and Labeling: Equipment, specialties, and accessories that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
 - E. Product Options: Irrigation system piping, specialties, and accessories are based on specific types, manufacturers, and models indicated. Components with equal performance characteristics produced by other manufacturers may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by the Architect. The burden of proof of product equality is on the Contractor. Any substitutions must be approved by the Architect in writing prior to installation per section 1.10.
- 1.6 PROJECT CONDITIONS
- A. Perform site survey, research public utility records, and verify existing utility locations. Verify that irrigation system piping may be installed in compliance with original design and referenced standards. Verify municipal water source provides level of pressure required for system design.
- 1.7 SEQUENCING AND SCHEDULING
- A. Coordinate irrigation systems work with landscape work specified and in the Drawings. Refer to Architectural Plans for information regarding the dates for turf installation.
- 1.8 EXTRA MATERIALS
- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below. Package them with protective covering for storage and label clearly describing contents.
 1. Remote Valves: Furnish one (1) of each size specified.
 2. Sprinklers: Furnish four (4) of each type of sprinkler used.
 3. Valve Keys: Furnish two (2) for each type of valve.
 4. Quick Couplers: Furnish two (2) of each size specified.
 5. Quick-Coupler Hose Swivels: Furnish one (1) for each quick coupler installed.
 6. Quick-Coupler Operating Keys: Furnish one (1) for each quick coupler installed.

1.9 IRRIGATION RECORD DRAWINGS

- A. Record accurately, on one set of black and white prints of the site plan, all installed work including both pressure and non-pressure lines and pipe sizes.
- B. Upon completion of each increment of work, transfer all such information and dimensions to the print. The dimensions shall be recorded in a legible and workmanlike manner. Maintain as-built drawings on site at all times. Make all notes on drawing in pencil (no ball point pen). When the work has been completed, transfer all information from the field record print to a set of reproducible drawings.
- C. Dimension from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavements, etc.). Locations shown on as-built drawings shall be kept day to day as the project is being installed. All dimensions noted on drawings shall be 1/8 inch in size (minimum).
- D. Show locations and depths of the following items:
 - 1. Point of connection, including Flow Sensor Assembly
 - 2. Routing of sprinkler pressure lines
 - 3. Gate valves
 - 4. Sprinkler control valves
 - 5. Quick coupling valves
 - 6. Routing of control wires, including Flow Sensor Assembly wires
 - 7. Sprinkler heads
 - 8. Other related equipment
- E. Provide typewritten schedule indicating length of time each irrigation valve (water zone) is required to be open to provide determined amount of water.

1.10 SUBSTITUTIONS

- A. Coordinate substitutions per Division One.
- B. Substitutions to the specified equipment will be permitted with the express written approval of the Architect. Substitutions will be approved only when the substituted item is equivalent or better in quality and performance than the item originally specified. The final determination for "equivalents" rests with the Architect. Their decision shall be final and binding.

1.11 WARRANTY

- A. Warranty system against defects of installation and material for a period of 2 years from date of Substantial Completion. Guarantee shall also cover repair or damage to any part of the premises resulting from leaks or other defects in material, equipment and workmanship to the satisfaction of the Architect. Repairs, if required, shall be done promptly upon notification by the Owner, and, at no cost to the Owner as specified herein.
- B. As part of the warranty, the Contractor shall be responsible for deactivating and winterizing the system prior to the onset of the freezing season and for reactivating the system at the onset of the spring growing season; each event must be accomplished once during the warranty period. In the event the system is completed in a season when it will not be in use, the Contractor shall winterize the system upon completion of testing (and approval by the Architect) and reactivate the system in the spring. The Contractor shall SUBMIT a letter to the Architect certifying that the system was winterized and drained and indicate the date such action was accomplished. The Contractor shall be responsible for any damage resulting from failure to comply. Contractor shall instruct and demonstrate winterization and startup techniques for Owner.

1.12 SYSTEM REPAIR

- A. Warranty Period System Repair: The irrigation sub-contractor shall respond to the site within two hours from notification by Richland School District for irrigation repairs including but not limited to; leaks, line breaks, control system failures, general repairs, etc. Failure to respond within the time established will result in the Richland School District force account mitigating the issue with costs (not limited to labor and materials) charged

back to the contractor.

- B. Construction and Maintenance Period System Repair: The irrigation sub-contractor shall respond to the site within two hours from notification by Richland School District for irrigation repairs including but not limited to; leaks, line breaks, control system failures, general repairs, etc. Failure to respond within the time established will result in the Richland School District force account mitigating the issue with costs (not limited to labor and materials) charged back to the contractor.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. All materials used throughout the system shall be new, unused, and in perfect condition. Refer to the irrigation materials legend, notes, detail drawings and these specifications for specific equipment to be used. Equipment or materials installed or furnished without prior approval of the Architect may be rejected and the Contractor required to remove such materials from the site at his own expense.
- B. Substitutions: Under provisions of Division 1 and 328400, paragraph 1.10.
 - 1. Where "Rain Bird" products are specified or shown, they are selected by the owner as a physical and quality standard for the procurements. This is a no substitute specification which has been determined to be in the best interest of the owner in the standardization of irrigation components and controls. This standardization provides the opportunity for long term reduction of operations maintenance and repair cost associated with the irrigation systems.

2.2 PLASTIC PIPE AND ACCESSORIES

- A. Pipe
 - 1. Pipe walls shall be uniform, smooth, glossy, and free of interior or exterior extrusion marks; pre-belled or straight to receive solvent-weld couplings; 20-foot standard lengths.
 - 2. Pipe shall be marked with manufacturer's name, class of pipe, NSF seal, and date/shift of manufacturing run.
 - 3. PVC Pipe: ASTM D1785
- B. Fittings: PVC - ASTM D2464, D2467.
- C. Irrigation System Plastic Pipe
 - 1. Mainline: 3-inch and larger shall be PVC Schedule 40 with rubber gasket joints.
 - 2. Laterals: PVC Schedule 40 plastic pipe and solvent-weld joints.
 - 3. Sleeving: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type fittings; and solvent-cemented joints.
 - 4. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are used.
- D. Pipe and Tube Fittings
 - 1. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are used.
 - 2. Polyvinyl Chloride (PVC) Plastic Pipe Nipples: ASTM D 2464, Schedule 80, threaded.
 - 3. Polyvinyl Chloride (PVC) Plastic Pipe Fittings: ASTM D 2467, Schedule 40, socket-type.
 - 4. "Leemco" or "Harco" Push-on joint Ductile Fittings: for all pipes 3" and larger.
 - 5. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion. These devices are a combination of copper alloy and ferrous metal; threaded- and solder-end types, matching piping system materials.
 - a. Dielectric Unions: Factory-fabricated, union assembly, designed for 250 psig (1725 kPa) minimum working pressure at 180 deg. F (82 deg. C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME 81.20.1.

- b. Transition Fittings: Manufactured assembly or fitting, with pressure rating at least equal to that of system and with ends.
- 6. Unions: When pipe is 1.5" or larger, use galvanized unions (main and lateral). With pipe smaller than 1.5", Schedule 80 unions may be used. Galvanized unions shall be assembled with pipe thread lubricant "pipe dope" to prevent corrosion.

2.3 JOINING MATERIALS

- A. Solvent Cement: ASTM F 656 primer and ASTM D 2564 solvent cement in color other than orange.
- B. In temperatures below 40 degrees Fahrenheit, use "weld on 727 hot or cold" with primer.
- C. When sealing galvanized pipe threads, use RectorSeal Tru-Blu Vibration Resistance Pipe Thread.

2.4 VALVES

- A. General: Valves are for general-duty and underground applications. Refer to "Valve Applications" Article for locations of various valve types specified in this Article. Refer to "Control Valves" Article for control valves and accessories.

2.5 CONTROL VALVES

- A. Description: Manufacturer's standard control valves for circuits, of type and size indicated on Drawing, and as follows:
 - 1. Angle Valves: Bronze construction, non-rising stem, inside screw threaded ends and as noted on the Drawings.
 - 2. Automatic Control Valves: Diaphragm-type, normally closed, with manual flow adjustment, and operated by 24-volt-a.c. solenoid.
 - 3. Quick-Couplers: Factory-fabricated, shall be red brass and stainless steel one piece body with hose swivel and operating key and as noted on the Drawings.
 - 4. Locking Top: Include vandal-resistant, locking feature with 2 matching keys.
 - 5. Drain Valve: As noted on the Drawings.
 - 6. Isolation Gate Valves: Smith-Cooper 250# gate valve, epoxy-coated, ductile iron, flanged, AWWA C515, resilient wedge valve with non-rising stem and op-nut. Size to match line size. Install in valve box, size adequate for maintenance access. Minimum 15" x 21".
 - a. "Harco" valve to fitting restraint can be used in lieu of flanged valve assembly.
 - 7. Air release valve: 2" air release valve from "Ames" or "Waterman", install in valve box.
 - 8. "Leemco" or "Harco" Ductile Iron Lateral Connection System.
- B. Control Valve Boxes and Cover: Rain Bird thermo-plastic valve boxes with lockable, snap-top lids. Color: Green. Size as required for application or as noted on drawings, maximum one (1) valve per box.
 - 1. Drainage Backfill: Cleaned gravel or crushed stone as shown on the drawings. Cover gravel with layer of filter fabric.
- C. Service Boxes for Key-Operated Control Valves: Rain Bird. Color: Green. Size and type as shown on Drawings.
 - 1. Include valve key, 48 inches (915 mm) long with tee handle and key end to fit valve.
- D. Irrigation System Controls
 - 1. Controller: As noted on the Drawings. All control wires that are above ground shall be installed in conduit. Electrical wiring shall be installed according to local code. Provide surge protection and grounding per manufacturer's recommendations. All wires not located within the main line trench shall be placed in rigid conduit. Conduit located in the ground may be electrical conduit (gray color), and conduit above ground shall be metal electrical conduit. Note that conduit leading to controller housing shall be metal.
 - 2. Controller Housing: Weatherproof, watertight, with lockable access door.
 - 3. Valves: Electric Solenoid type and size of control valves as noted on the Drawings,

including required fittings and accessories.

2.6 SPRINKLERS

- A. Description: Manufacturer's standard sprinklers designed to provide uniform coverage over entire area of spray shown on Drawings at available water pressure, as follows:
1. Housings: Plastic, except where material is specified.
 2. Pop-Up Spray: Fixed pattern, with screw-type flow adjustment and stainless-steel retraction spring.
 3. Pop-Up Rotary Spray: Gear drive, full-circle and adjustable part-circle type.

2.7 AUTOMATIC CONTROL SYSTEM

- A. Description: Low-voltage 2-wire controller system, made for control of irrigation system automatic control valves. Controller operates on 120 volts a.c. building power system, provide 24 volts a.c. power to control valves, and includes stations for at least the number of control valves indicated. Size and type as shown on Drawings.
- B. Control Enclosures: Weatherproof enclosure with locking cover and 2 matching keys. Enclosure construction complies with NFPA 70 and NEMA 250, Type 4, and includes provision for grounding. All control wires that are above ground shall be installed in conduit. Electrical wiring shall be installed according to local code. Provide surge protectors in all controllers.
1. AG 240 V Surge Arrester: As noted on the drawing. Install in approved J-box next to controller. Install per manufacturer recommendations.
 2. MGP-1 Maxi Grounding Plate: As noted on the Drawings. Install with approved grounding per manufacturer's recommendations. Install per manufacturer's recommendations.
- C. Transformer: Internal-type, and suitable for converting 120 volts a.c. building power to 24 volts a.c. power.
- D. Controller Stations for Automatic Control Valves: Each station is variable from approximately 1 to 60 minutes. Include switch for manual or automatic operation of each station.
- E. Timing Device: Adjustable, 24-hour, 14-day clock to operate any time of day. Include provision for the following settings:
1. Setting to skip operation any day in timer period.
 2. Setting for operation every other day.
 3. Settings for operation 2 or more times daily.
 4. Include manual or semi-automatic operation without disturbing preset automatic operation.
 5. Provide NI-CAD battery and trickle charger to automatically power the timing device during power outages.
- F. Wiring:
1. All irrigation control wire (hereafter referred to as two-wire) from the Controller to the field devices must be Polyethylene double-jacketed or UF-B UL PVC double-jacketed two-conductor solid core designed for direct burial systems. The following is recommended:
 - a. All two-wire shall be soft drawn, annealed, solid copper conforming to ASTM 33. Conductor insulation must be 4/64-inch thick PVC, conforming to UL Standard #493 for thermoplastic-insulated style UF (Underground Feeder), rated at 60 degrees C.
 - b. The two insulated conductors are laid in parallel and encased in a single outer jacket of 3/64-inch thick, high density, sunlight resistant polyethylene conforming to ICEA S-61-402 and NEMA WC5, having a minimum wall thickness of 0.045-inch.
 - c. The two conductors must be color-coded: normally one conductor red and one black. Both conductors shall be the same size: 14 AWG.
 2. All wire crossing water, attached to bridges, going under paving, or where conditions

- require protection, shall be housed in conduit or sleeves. All out-of-ground conduits shall be rigid metal. All buried conduit may be PVC.
3. All splices shall be water-tight. All connections made inside the box to connect the two-wire to the valve shall be made using a dry-splice connector DBR/Y-6 on the two-wire side and the same on the valve side. No exceptions or substitutes. Each connector shall be completely sealed and water-proof.
 4. All other splices in two-wire shall be housed in a separate round valve box and use DBR/Y-6 connectors. No exceptions or substitutes.
 5. Lightning arrestors and eight (8) foot long by 5/8-inch diameter copper ground rods shall be used as recommended by the Baseline Irrigation Solutions Company, and be installed per manufacturer recommendations and installation details of this project. Attach bare copper wire to ground rods using Cadweld™ type connection and install in eight (8) inch round valve box.
 6. No aluminum wire shall be used on this project.
 7. Wire to be size #14 not to exceed 1500 linear feet before sizing up to #12 wire.
- G. Communication Cable.
1. All cable required between controllers and flow sensor shall be REA Pe-39, 19 gauge, conductor-solid annealed uncoated copper conforming to ASTM-B3; insulated with expanded polyolefin surrounded by solid polymer to ensure low loss long transmission capability.
 2. Where cable passed under paving, walls or any other paved areas, it shall be installed in a PVC Schedule 40 pipe sleeve of proper size required for the number of cables to be placed in it. The 2-wire path is permitted to be laid in the same trench with the 117 VAC cable as much as possible by laying each in opposite sides of the trench.
- H. IQ Capability
1. Per directions from the Richland School District (RSD), provide Rain Bird IQ v.2.0 Central Control Software as necessary to operate the new and future controllers. Install on RSD-provided computer and make functional for this school's irrigation operation.
- 2.8 VALVE BOXES
- A. Remote Control Valve: Rain Bird rectangular box, green with locking lid.
 - B. Gate valves and Quick Coupler Valves: Rain Bird 10" minimum round box, green with locking lid.
- 2.9 CONTROLLER STATION NUMBER IDENTIFICATION TAG
- A. Standard 1.0. tags by: T. Christy Enterprises, Inc. 655 E. Ball Road, Anaheim, CA, 92805-5910, (714) 507-3300, (800) BLU-GLUE.
- 2.10 FLOW METER
- A. As shown on the drawings.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Investigate and determine available water supply water pressure and flow characteristics.
- 3.2 EXISTING CONDITIONS
- A. Provide temporary watering to existing trees to remain on site, and temporary irrigation to maintain existing irrigation areas to remain north of project site. Priority shall be given to establishing new mainline and water service to existing system to remain north of project site during Phase One.
- 3.3 PREPARATION

- A. Set stakes to identify proposed sprinkler locations. Obtain Irrigation Designer's approval before excavation.
- 3.4 PAVING WORK
- A. Install piping in sleeves where crossing sidewalks, roadways, parking lots, playgrounds, and other hard surfaces.
 - 1. Install piping sleeves by boring or jacking under existing paving, where possible.
 - 2. If it is necessary to cut pavement sections, pavement shall be replaced in cut areas.
- 3.5 PIPING APPLICATIONS
- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and aboveground may be joined with flanges instead of joints indicated.
 - B. Use pipe, tube, fittings, and joining methods according to the following applications.
 - C. Pressure Piping Underground: Use the following:
 - 1. 4 Inches: ASTM D 1785, Schedule 40, rubber gasketed, polyvinyl chloride (PVC) plastic pipe; ASTM A 536 push on ductile iron fittings.
 - D. Circuit Piping: Use the following:
 - 1. All Sizes: ASTM D 2467, Schedule 80, PVC plastic, socket-type pipe fittings; and solvent-cemented joints.
 - E. Sleeves: ASTM D 1785, Schedule 80, polyvinyl chloride (PVC) plastic pipe; ASTM D 2467, Schedule 80, PVC plastic, socket-type fittings; and solvent-cemented joints. Sleeve diameter shall be twice the size of carrier pipe installed in sleeve with minimum sleeve size being 4". Extend sleeves 18" beyond walk or pavement edge.
- 3.6 JOINT CONSTRUCTION
- A. Threaded Joints: Thread pipes with tapered pipe threads according to ASME B 1.20.1, apply tape or joint compound, and apply wrench to valve ends into which pipes are being threaded. When sealing galvanized pipe threads, use RectorSeal Tru-Blu Vibration Resistance Pipe Thread.
 - B. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.
 - 1. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.
 - C. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Refer to "Piping Systems - Common Requirements" Article for joining dissimilar metal piping.
 - D. Provide "Leemco" or "Harco" joint restraints at all gasket fittings where a change of direction occurs and at required spigot and bell pipe connections. Install all joint restraints per manufacturer's recommendations.
 - 1. Contact Tony Garner @ (208) 631- 7787 to provide an installation clinic for all Leemco fittings and joints restraints. Coordinate with Landscape Architect.
 - 2. Contact Mike Scheel @ (434) 382-7930 to provide an installation clinic for all Harco fittings and joint restraints. Coordinate with Landscape Architect. Refer to the Harco joint restraint selection guide for additional information:
<http://www.harcofittings.com/Products/DI/Irrigation/Restraints>
- 3.7 PIPING SYSTEMS - COMMON REQUIREMENTS
- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
 - B. Install components having pressure rating equal to or greater than system operating

pressure.

- C. Install piping free of sags and bends. Deflections angles shall not exceed manufacturer's recommendations.
- D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Piping Connections: Except as otherwise indicated make piping connections as specified below.
 - 1. Install unions, in piping 2 inches (ON 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inch (ON 50) or smaller threaded pipe connection.
 - 2. Pipe larger than 1.5" in diameter use galvanized unions (main and lateral). If pipe is small than 1.5", Schedule 80 unions may be used.
 - 3. Install flanges, in piping 2-1/2 inches (ON 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 - 4. Install dielectric fittings to connect piping of dissimilar metals.

3.8 PIPING INSTALLATION

- A. Install underground polyvinylchloride (PVC) plastic pipe according to ASTM D 2774.
- B. Lay piping on solid subbase, uniformly sloped without humps or depressions.
 - 1. Install polyvinyl chloride (PVC) plastic pipe in dry weather when temperature is above 40 deg. F (4 deg. C). Allow joints to cure at least 24 hours at temperature above 40 deg. F (4 deg. C) before testing, unless otherwise recommended by manufacturer.
- C. Minimum Cover: Provide following minimum cover over top of buried piping:
 - 1. Pressure Piping: 24 inches.
 - 2. Circuit Piping: 18 inches.
 - 3. Sleeves: Match Pipe Depth.
- D. Boring
 - 1. Locations: Boring shall be used to route pipe, wiring or both under concrete structures such as walks or curbs where trenching is impractical. Sleeves shall be installed in all bored holes.
 - 2. Method: Boring shall be accomplished with a drill, auger, water jet, or any other instrument approved by the Owner's Representative capable of producing a precise hole. Boring shall not disturb overlaying structures or cause settlement and damage to those structures.
- E. Install piping under sidewalks and paving in sleeves.
- F. Back-filling
 - 1. Inspection: The trenching shall not be backfilled until inspection and pressure testing has been completed and the pipe installation, including the grade, alignment and jointing has been found to be in compliance with the requirements of the plans and specifications.
 - 2. Around and Over Pipe:
 - a. Backfill material consisting of bedding sand shall be used in backfilling around and over the installed pipe. Install sand 3" above the pipe and 3" below the pipe. At the very least, sand bed all main lines and remove all rocks larger than 1" from other trenches.
 - b. The select material shall be obtained from the excavation material removed from the trench and shall be processed by screening, sifting, or selective sorting, so as to produce the type of backfill herein specified. The Contractor may at his option and own expense provide an acceptable imported material.
 - c. Backfill material shall be carefully deposited around and over the pipe in layers not more than 6 inches thick, loose measurement, wetted to optimum moisture content and uniformly compacted to at least 95 percent of the maximum density obtainable at optimum moisture content as

- determined by AASHTO T99 Method A or D (latest revision), until the pipe has a cover depth of at least 12 inches.
3. Remainder of Trench Backfill:
 - a. The remaining depth of the trench shall be backfilled to existing finish grade, with excavation material removed from the trench, which shall be wetted or dried to near optimum moisture content. Backfill with select material and compact with water to 90% to preclude future settlement.
 - b. Contractor shall be required to repair any settling problems which occur in the trench locations for the duration of the warranty period.
 4. On all main lines (including stubs to control valves) place electric trace tape on top of the pipe so it can be located in the future.
- G. Pipe fittings
1. All mainline piping shall use "Leemco" or "Harco" ductile iron push on type fittings. Provide "Leemco" or "Harco" joint restraints at all gasket fittings where change of direction occurs. See drawings for details.
 - a. Provide "Harco" restraints at the pipe and spigot and bell ends where required. Refer to the Harco joint restraint selection guide for more information:
<http://www.harcofittings.com/Products/DI/Irrigation/Restraints>
 2. All circuit piping shall use Schedule 40 socket type fittings.
- 3.9 VALVE APPLICATIONS
- A. Drawings indicate valve types to be used.
- 3.10 VALVE INSTALLATION
- A. Valves: Install underground valves in valve boxes as shown on Drawings.
 - B. Control Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install union on downstream side. Maximum (1) valve per valve box.
 - C. Place 6 inches minimum of gravel below control valves for drainage. Maintain 4 inches minimum between bottom of valves and top of gravel. Place filter fabric barrier between gravel and valves. Valve box shall be free of dirt and debris.
- 3.11 SPRINKLER INSTALLATION
- A. Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.
 1. Install lawn sprinklers at manufacturer's recommended heights.
 2. Install shrubbery sprinklers at heights indicated.
 3. Locate part-circle sprinklers to maintain a minimum distance of 12 inches from walls and 2 inches (50 mm) from other boundaries, unless otherwise indicated.
 4. Sprinkler Head Risers: Rotor pop-up sprinkler shall have an adjustable riser assembly (triple swing joint Rain Bird TSJ Series or approved equal). Stationary spray pop-up heads or shrubs spray heads shall have an adjustable riser assembly (triple swing joint) or low-density polyethylene flex pipe as shown on Drawings details. Triple swing joint fittings shall be of Schedule 80 PVC. Flex pipe risers shall be 12-inch long minimum and 18-inch maximum linear low-density polyethylene pipe with spiral barb fittings and 90-degree ell as shown on details on Drawing.
 5. Quick coupling valves shall be installed with an adjustable riser assembly (triple swing joint) and a Leemco quick coupler stabilizer, size as necessary.
- 3.12 AUTOMATIC CONTROL SYSTEM INSTALLATION
- A. Install controllers and controller enclosure according to manufacturer's written instructions and as indicated.
 - B. Install control and communication wiring in same trench with piping. Where wiring leaves from piping trenches, install wiring in conduits. Provide 24" coiled slack wire for used

wires and 36" coiled slack wire for spare wires in each remote control valve box.

3.13 CONTROLLER STATION NUMBER IDENTIFICATION TAG

- A. Fasten securely an I.D. tag station number to each corresponding control valve.

3.14 FLOW METER

- A. Install per manufacturer's recommendations.

3.15 TRENCHING

- A. Trench Size:
 - 1. Minimum Depth: as necessary to provide 24" of cover for mainline, sleeves, and wires.
 - 2. Minimum Depth: as necessary to provide 18" of cover for all lateral lines.
 - 3. Minimum Width: 4-inch pipe and larger - 12 inches.
 - 4. Minimum Width: 3-inch pipe and smaller - 9 inches.
- B. Trench to accommodate grade changes and slope to drains.
- C. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.16 CONNECTIONS

- A. Connect piping to sprinklers, devices, valves, control valves, specialties, and accessories.
- B. Connect water supplies to irrigation systems. Include back-flow preventers on potable water supplies.
- C. Electrical Connections: Connect to power source, controllers, and automatic control valves.
- D. Flow Meter Connection: Run wiring from flow meter to a junction box located at controllers for future connection to Rain Bird IQ Central Control.

3.17 FIELD QUALITY CONTROL

- A. Testing: Perform test of piping and valves before back-filling trenches. Piping may be tested in sections to expedite work. Owner's representative must be present for testing.
 - 1. Make all necessary provisions for thoroughly bleeding the line of air and debris.
 - 2. Before testing, fill the line with water for a period of at least 24 hours.
 - 3. After valves have been installed, test all live water lines for leaks at a pressure of 100 psi for a period of two hours, with all couplings exposed and with all pipe sections center-loaded.
 - 4. Furnish all necessary testing equipment and personnel.
 - 5. Correct all leaks and retest until acceptance by the Project Landscape Architect.
- B. Field inspection and testing will be performed under provisions of Division 1.
- C. Installer's Field Service
 - 1. Prepare and start systems under provisions of Division 1.
 - 2. Provide one complete spring start-up and a fall shutdown, including winterization to blow out entire system with compressed air.
- D. Adjust work under provisions of Division 1.
- E. Change and/or adjust head types for full water coverage as directed.
- F. Adjust nozzle spray pattern as required to avoid water spray on building walls, roads or sidewalks.
- G. Using formulas provided by the Irrigation Association, the Contractor shall calculate the yearly schedule for the system. Establish the date the irrigation system is turned on and off and determine the appropriate schedule for the system based on ET for the established water window. Use the seasonal adjust setting on the controller and set based on the time of year and required water.

3.18 CLEANING AND ADJUSTING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure

- required for each sprinkler circuit.
- C. Carefully adjust lawn sprinklers so they will be flush with, or not more than 2 inch (13 mm) above, finish grade after completion of landscape work. Adjust so that sprinklers do not spray on buildings or walls.
- D. Adjust settings of controllers and automatic control valves to insure proper watering of all landscaping.

3.19 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:
 - 1. Verify that specialty valves and their accessories have been installed correctly and operate correctly.
 - 2. Verify that specified tests of piping are complete.
 - 3. Check that sprinklers and devices are correct type.
 - 4. Check that damaged sprinklers and devices have been replaced with new materials.
 - 5. Check that potable water supplies have correct type back-flow preventers.
 - 6. Energize circuits to electrical equipment and devices.
 - 7. Adjust operating controls.
- B. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinklers are adjusted to final position.
- C. Contractor shall perform a water audit on the irrigation system after installation and prior to planting to ensure proper head spacing was achieved during construction. Audit shall be performed based on the Irrigation Association Irrigation Audit Guidelines.
 - 1. Required Low Quarter Distribution Uniformities shall be as follows:
 - a. Sprays: 55%
 - b. Rotors: 70%
 - c. Drip: 80% Emission Uniformity

3.20 DEMONSTRATION

- A. Demonstrate system successful operation before installation of sod or landscaping.
- B. Provide irrigation system demonstration under provisions of Division 1. Record on DVD video format.
- C. Demonstrate to Owner that system meets coverage requirements and that automatic control functions properly.
- D. Identify to Owner that provisions for future addition by Owner of Rain Bird IQ Central Control system have been installed.
- E. Demonstrate to and train Owner's maintenance personnel on the proper operation of equipment, sprinklers, specialties, and accessories. Review operating and maintenance information, including start up and winterization procedures. Refer to Specification 01 29 00 Section 1.3; B; 10 for money to be set aside in the Schedule of Values for owner training.
- F. Provide 7 days written notice in advance of demonstration.

3.21 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

END OF SECTION 32 84 00

SECTION 32 84 23 FIELD & TRACK WASHAWATER SYSTEMS

PART 1 - GENERAL

- 1.01 DESCRIPTION: Furnish and install Field & Track Washwater System in conformance with the drawings and specifications, complete and ready for use. The work consists of furnishing all materials necessary for a complete installation, including, pipe, pipe sleeves, fittings, valves, specialty valve boxes, swing joints, and all appurtenances related thereto. Included shall be all labor necessary for installation, including trenching, plumbing, back-filling, adjustments, and all other items of labor necessary for a satisfactory operating system.
- 1.02 QUALITY ASSURANCE:
- A. Basic Qualifications - The Contractor must be a Washington State Landscape Industry Professional and has passed the Certified Landscape Professional (CLP) exam. The irrigation system must be installed under the direct supervision of a Certified Irrigation Technician or Journey Plumber. All potable water system components shall be installed by a Washington State Licensed Plumber and all testing of the backflow prevention equipment shall be done by a Washington State Certified Backflow Assembly Tester (BAT).
 - B. Testing Sequence
 1. Pressure Test and Visual Inspection of trenches, main lines, and valves (at 150 psi, for 30 minutes).
 2. Pressure Test and Visual Inspection of trenches, lateral lines and swing joints (at the design pressure).
 3. All System Components must be inspected and approved prior to backfill.
- 1.03 REFERENCE SECTIONS:
- | | |
|----------|----------------------------|
| 31 20 00 | Earth Moving |
| 32 12 18 | Track Asphalt Paving |
| 32 13 13 | Concrete Paving |
| 32 18 23 | Track Rubberized Surfacing |
| 32 18 24 | Field Synthetic Turf |
- 1.05 SUBMITTALS:
- A. Submit complete materials list prior to performing any work. Submit manufacturer catalog data and full descriptive literature, including current manufacturer's price list.
 - B. Equipment or materials installed or furnished without prior approval of the Architect will be rejected and such materials will be required to be removed and replaced with approved materials at the complete expense of the Contractor.
 - C. Submit shop drawings of the following assemblies for review and approval prior to beginning work;
 1. Isolation Valves with Unions
 2. Quick Coupler Valves with swing joints

3. Where directed, the Architect may require preinstallation shop drawings of piping in areas where multiple zone piping and/or other underground utilities are present to verify proper clearance and cover.

1.06 PROJECT CONDITIONS:

- A. Underground utilities and elements: The Contractor shall call Utility Notification Center at (811) or (800) 424-5555 or click www.callbeforeyoudig.org to locate all underground utilities (on or near Public Rights-of-Way / Property Lines) prior to digging and/or driving stakes.
- B. Site Inspection and Layout: Before proceeding with any work, the Contractor shall inspect the site, carefully checking all grades and verifying all dimensions and conditions affecting the work to satisfy him/her that he/she may safely proceed. Changes or alterations to the system to meet actual conditions shall be made at the Contractor's expense. Always use appropriate fittings for changes in direction or elevation. Do not bend the pipe more than that allowed by this specification. The irrigation plan is diagrammatic and is not intended to show exact locations of existing or proposed piping, valves or controllers. Locate new items as closely as possible to related curbs, walls, fences or edges of paving. Pipelines shown parallel on drawing may be placed in a common trench but separated by at least 6 inches and all pipes of dissimilar materials shall be installed per UPC and APWA standard details.
- C. Take care to neither disturb nor damage any existing above ground or underground utilities or elements. Keep streets, sidewalks and site clean, free from debris and affected drains open and free flowing at all times.
- D. During the installation of the new wastewater system, if underground utilities are encountered, including (but not limited to) existing irrigation systems, the Contractor shall notify the Architect two (2) working days in advance and perform repairs to that system per this section and/or as directed by the Architect. This shall also apply to the connection of wastewater systems to landscape systems.

1.07 WASHWATER SYSTEM WARRANTY:

- A. Contractor shall provide a One Year warranty as per the requirements of the General Conditions of the Contract.
- B. The Warranty shall include restoration of all damage due to settlement of trenches.
- C. The Warranty shall include one complete winterization and one complete de-winterization of the washwater system.

PART 2 - PRODUCTS

2.01 FOR ALL SYSTEM PIPING 3" AND SMALLER - PVC (POLYVINYL CHLORIDE) PIPE, FITTINGS, PRIMER AND GLUE:

- A. All PVC Pipe shall be Schedule 40 PVC (or better) and shall conform to all requirements of ASTM D1785-86.
- B. All PVC Pipe shall be marked with the manufacturer's name, class of pipe and NSF seal. Pipe shall bear no evidence of interior or exterior extrusion marks. Pipe walls shall be

uniform, smooth and glossy. Pipe may be pre-belled or with individual solvent-weld couplings.

- C. All PVC Pipe shall be solvent welded pipe. All PVC pipe must be delivered in at least twenty foot (20') lengths.
- D. All PVC fittings shall be of the solvent welded type except where risers, valves, etc., require threaded transition fittings. All threaded PVC tees, fittings, adaptors and nipples shall be Schedule 80 PVC (or better) and shall conform to the requirements of ASTM D2466-78.
- E. Thrust Blocking is required for all mainline pipe where necessary and as directed by the Architect in the field.
- F. All PVC pipes and fittings for swing joints shall conform to all requirements of ASTM D3139. No additional threaded PVC nipples of any kind are allowed in swing joint fabrications. All swing joints shall be threaded into Schedule 80 PVC tees or Schedule 80 PVC 90-degree ells that are glued into the Schedule 40 mainline and lateral pipes.
- G. Use Teflon tape on all threaded fittings, regardless of pipe type.
- H. Primer color shall be Purple and glue color shall be Gray.

2.02 SLEEVES:

- A. Sleeves required for main and lateral lines located under paving (pathways within the park site) where light vehicles are anticipated, shall be, Schedule 40 PVC (or better). The inside diameter (I.D.) of the sleeve shall be twice (2 times) the outside diameter (O.D.) of the inserted pipe with a maximum of one (1) insert pipe per sleeve. All wiring shall be in its own separate Schedule 40 PVC sleeve, independent from the piping sleeves.
- B. All sleeves shall be inspected and approved by the Architect after forms are placed (for wall penetrations) and/or before paving operations are executed.

2.03 MANUAL VALVES:

A. Gate Valves

- 1. All Manual Valves sized 2" Pipe Size and larger to conform to the latest revision of AWWA Standard C-509.
- 2. All parts shall be accessible for repair or maintenance without removing the body from the line.
- 3. The body, bonnet, and seal plate shall have a factory applied thermoplastic epoxy coating on all interior and exterior surfaces. The wedge shall be cast iron completely encapsulated with a resilient elastomer material permanently bonded to the wedge and shall have a rubber tearing bond that meets ASTM D429.
- 4. The gate valve shall be rated for 200 psi WWP.
- 5. Gate Valves up to 2" shall utilize a hand-wheel actuator, larger than 2" a square-top actuator with "Tee" type key shall be provided.
- 6. Two 42" valve operating keys are to be furnished.

B. Ball Valves

- 1. All ball valves shall be full port, forged brass, ISO-9002 certified, 600 WOG - 150 SWP

2. Provide threaded ends with brass unions and compatible couplers.
3. Matco-Norca #758 Ball Valve.

2.04 QUICK COUPLING VALVES (QCV):

- A. Shall be of the type, manufacture and size shown on the drawings and/or the following: Buckner QB44LRC-10 with 1 inch outlet, single lug 2-piece with locking lid and matching key, or approved equal. All quick coupling valves shall be installed in a 10" diameter valve box, as shown on the Details.
- A. Shall be one (1) inch, all brass, and two piece bodies, with locking brass tops and have galvanized steel swing joints as shown in the Details. Provide five (5) operating keys and hose swivels on each project.
- C. For Quick Coupler Valve installations on ballfield infields (generally located behind the pitcher's mound) a 1-1/2" brass, single piece body QCV shall be used. In addition to the swing joint described below, an additional three (3) feet of 1-1/2" O.D. Sch. 40 galvanized steel pipe shall be installed at the end of the pipe to the QCV and shall be installed as shown on the Details.

2.05 SWING JOINTS:

- A. Swing joints for quick couplers shall be triple swing joints using schedule 40 galvanized steel with threaded fittings. Swing joints shall consist of street ells, ells, and nipples for full adjustability. Galvanized swing joint, quick coupler assemblies shall be installed in valve boxes, per the Details.
- B. Pre-fabricated swing joints, for irrigation heads, shall be triple swing joints, using Schedule 80 or Class 315 PVC threaded fittings. Swing joints shall consist of street ells, ells, and nipples for full adjustability. Fittings shall have "O" ring seals.

2.06 VALVE BOXES:

- A. Valve boxes shall be of the type, manufacture and size shown on the Plans and Details and/or the following:
 1. Use Pentek or NDS Pro Series 10 inch diameter round valve boxes with locking lids for quick coupler valves in landscape, green color, or approved equal.
 2. Use Pentek Super Jumbo Valve Boxes with Pentagon Lock or NDS Pro Series Jumbo boxes with bolt down locking lids and extensions as required (for single isolation valve assembly in landscape only), green color, or approved equal.
 3. Use Sportsfield Specialties "TurfCool Box" for individual Quick Coupler Valves located in synthetic turf or rubberized surfacing as approved.
 4. Use Sportsfield Specialties "CommBox" for dual isolation valve / quick coupler valve assemblies in synthetic turf or rubberized surfacing as approved.
- B. Manual drain valves and individual gate valves shall be enclosed in a Cast Iron Roadway Box, as manufactured by Olympic Foundry, Tyler Pipe, or Pentek "Polyiron" 5-1/4" valve box, or approved equal, with bottom, top, and lid, sized and extensions, as required. Lid shall have the word "water" printed on it.
- C. Provide two (2) sets of all keys required for valves, valve box covers, and protective sleeve covers unless otherwise noted.

2.07 IDENTIFICATION:

- A. Underground - Type Plastic Line Markers (Detect-a-Tape): Permanent, bright-colored, continuous-printed plasticized aluminum tape, intended for direct-burial service; not less than 3" wide x 5 mils thick and shall be placed directly over the pipes at 6" below finished grades. Provide blue tape with black printing reading "CAUTION IRRIGATION LINE BURIED BELOW".
- B. Valve zone identification tags are required and shall be Christy's ID Tags, as manufactured by Christy Concrete Products, Inc., Portland, OR, or approved equal. Tags shall be made of polyurethane, incorporating an integral attachment neck and reinforced attachment hole and will be capable of withstanding 180 pounds pull force. Tag shall be 2 1/4" x 2 3/4" in size. All lettering shall be hot stamped in black and capable of withstanding outdoor use. Tag color shall be yellow shall be double sided and stamped with zone valve number.

2.08 BACKFILL MATERIALS:

- A. For backfill around all swing joints use common builder's sand.
- B. For suitable bedding material around all pipes and equipment as shown on the Details, use: native subgrade soil with no rocks or other debris more than 1 inch diameter or common builder's sand per Section 31 00 00 Earthwork.

PART 3 - EXECUTION

3.01 LAYOUT OF WASHWATER SYSTEM:

- A. Stake the washwater system following the design shown on the Plans before trenching begins. Alterations and changes to the layout may be expected in order to conform to the site conditions and to achieve the quick coupler valve spacing required. It is understood that corrective measures in the system may become necessary, but no changes or alterations to the system as planned shall be made without the prior authorization of the Architect.
- B. Before starting work, determine that work may proceed without disruption of the activities of other trades.
- C. The Contractor shall carefully check grades to ensure that the area is ready to begin work. Washwater trenching is not authorized where rough subgrade has not been approved. Refer to Section 31 00 00 Earthwork.
- D. The Contractor is responsible for taking all reasonable investigative actions and precautions when working around all utility systems.

3.02 TRENCHING:

- A. Prior to commencing trenching operations in any area, verify that rough subgrade has been approved.
- B. Trenches shall be excavated for all pipe to provide the minimum depth of cover below finish grade of 24" for live lines (mains), and 18" for laterals and all others, no wider at

any point than is necessary to lay the pipe or install equipment. Trenches shall be excavated with vertical sides. Sleeve where cover is planned to be pavement.

- C. Materials unsuitable for bedding of pipe to be removed to a depth 4" below trench bottom, and replaced with suitable bedding material as directed by the Architect. Suitable bedding material shall be: excavated trench material, free from rocks, roots, sticks, debris or other sharp objects over one inch in diameter; or sand, as required.
- D. All trenches must be straight, with appropriate pipe-fittings used to allow pipe to be laid without undue bending and not have abrupt changes in grade.
- E. The trench bottom must be free of rocks or sharp-edged objects.
- F. The use of an underground vibratory plow or similar device to pull pipe will not be permitted.

3.03 INSTALLATION

- A. Reserved.
- B. Brass Pipe and Fittings:
 - 1. Brass pipe shall be installed in accordance with the local Plumbing Code and as shown on the Plans and Details.
 - 2. Use 'Teflon' tape on all male threads to prevent leaks and corrosion.
 - 3. Wrap all brass pipes with black PVC tape where they pass through grouted openings in concrete vaults.
- C. Solvent Welded PVC Pipe and Fittings:
 - 1. The Contractor shall exercise care in handling, loading, unloading and storing to avoid damage. The pipe and fittings shall be stored under cover, and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat, so as not to be subject to undue bending or concentrated external load at any point. Any pipe that has been dented or damaged shall be discarded until such damage has been cut out and the pipe is rejoined with a coupling.
 - 2. PVC pipe ends shall be cut to ninety (90) degrees to the pipe length and cleaned of all cutting burrs prior to cementing. Use approved reaming tool. Pipe ends shall be wiped clean with a rag and lightly wetted with PVC primer. Cement shall be applied with a light coat on the inside of the fitting and heavier coat on the outside of the pipe. Pipe shall be inserted into the fitting and given a quarter turn to seat the cement. Excess cement shall be wiped from the outside of the pipe. Pipe will be tested as indicated elsewhere in these specifications. No back filling will be permitted other than at the centers of pipe lengths until the pressure test is completed.
 - 3. Appropriate primer shall be used with solvent glue. Solvent welded joints shall be given at least fifteen (15) minutes set-up time before moving or handling. Pipe shall be partially center loaded to prevent arching and slipping. No water shall be permitted in pipe until a period of at least ten (10) hours has elapsed for solvent weld setting and curing.
 - 4. Before pressure testing, soluble weld joints shall be given at least twenty-four (24) hours curing time.
 - 5. No PVC pipe may be threaded or connected to a threaded fitting without an adapter. Use Teflon tape on all male threads.

6. Great care must be taken to insure that the inside of the pipe is absolutely clean. Any pipe ends not being worked on must be protected and not left open.
 7. Repairs or connections to existing PVC pipe shall be done using 'Romac', or approved equal fittings. 'Romac' Model #511 (long version) repair coupling is required. No telescoping repair couplings will be allowed. An isolation valve is also required at that point of connection to allow for pressure testing of the new system.
- D. Reserved.
- E. Sleeves:
1. Pipe trenches located under areas of existing or new paving shall have sleeves installed. Sleeves shall extend 12" beyond the pavement on each side. Trenches shall be back-filled with sand (6 inches above and 4 inches below the pipe) and compacted in layers to 95% compaction, using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and shall be left in firm unyielding condition. All trenches shall be left flush with the adjoining grade. The Contractor shall set in place; cap and pressure test all piping under paving prior to paving work.
 2. All sleeves installed by the Contractor prior to and during the installation of the rest of the irrigation system shall be inspected by the Architect.
- F. Thrust Blocking:
1. Provide 3cf thrust blocking at all 45, 90, and tee fittings on all 2" washwater mainline installed inside the synthetic turf perimeter.
- G. Reserved.
- H. Reserved.
- I. Manual Valves:
1. All manual (gate, isolation, lateral isolation, shut-off or drain) valves shall be installed as shown in the Plans and Details.
- J. Quick Coupling Valves:
1. Quick coupler valves shall be located as shown on the plans or at approximately 100' intervals, unless otherwise directed by the Architect through the design review process. One additional quick coupling valve shall be installed at the Point of Connection (POC) for use of compressed air for winterizing the system.
 2. All quick coupling valves shall be installed in access boxes as shown on the Details.
- K. Backfilling:
1. Backfilling shall be done when pipe is not in an expanded condition due to heat or pressure. Cooling of the pipe can be accomplished by operating the system for a short time before back-fill, or by back-filling in the early part of the morning before the heat of the day.
 2. While backfilling the trenches fill and tamp around, 4 inches below and 6 inches above the pipe and fittings with approved suitable bedding material, or sand as

required. The remainder of the backfill shall contain no lumps or rocks larger than three inches. A six inch separation is required between all pipes when more than one pipe occupies the trench. If no sodding is required, the top 6 inch of backfill shall be replaced by topsoil where it exists (free of rocks over one inch, subsoil or trash) or selected fill soil or sand if soil conditions are rocky.

3. All roots, rocks and surplus excavation shall be removed from the site unless otherwise directed. Any turf areas buried under ditch excavation shall be raked clean of any excavated material.
4. Trenches under roads or paved areas shall be back-filled and tamped with a mechanical tamper in successive six inch (6") lifts. Paving shall be replaced to the satisfaction of the Architect.
5. Prior to completing backfill, place detection tape 6 inches below finished grades and directly above the installed lateral and supply mains for future line detection. Provide extra length to clearly expose ends in the valve boxes.
6. Before complete back-filling, all underground appurtenances including risers, valves, double check valve assembly, drain valves, and joints must remain exposed so that they can be viewed during testing.
7. The location, inspecting and testing provisions of these specifications will be strictly adhered to. If, for any reason, any part of the sprinkler system is back-filled before approved location, testing, or inspection is authorized, it must be completely uncovered and exposed until approved for back-filling by the Architect.

3.04 CLEAN-UP: Upon completion of operations and prior to watering, clean all adjoining areas such as paving, curbs, and lawns of debris caused by the work on this project, or any part of this project. All hard surfaced areas shall be washed clean. Daily clean up shall be required on all areas used for circulation, parking, or other daily use.

3.05 TESTING AND INSPECTIONS:

A. Pressure Testing:

1. Make hydrostatic tests in the presence of the Architect. No pipe shall be backfilled until it has been inspected, tested and approved.
2. Furnish necessary pump, gauges and all other test equipment.
3. All PVC main lines with gate (isolation) valves installed and closed shall be flushed and pressure tested with all joints exposed to one hundred fifty (150) psi until watertight. Maximum psi loss in a thirty (30) minute test period shall be five (5) PSI.
4. Similarly, all PVC lateral lines with risers installed and capped shall be flushed and pressure tested with all joints exposed to service line pressure required for design for 30 minutes. If the system requires a pump, the service line pressure is required with the pump in operation. Maximum PSI loss allowed shall be five (5) PSI. The Architect shall visually inspect all lateral lines, joints, and swing joints for leakage.
5. To be valid, all tests must be witnessed and approved by the Architect. The contractor must give at least two (2) working days notice prior to the anticipated date of inspection.
6. All gauges used in the testing of water pressures shall be certified correct by an independent testing laboratory immediately prior to use on the project.

B. EQUIPMENT SURVEYING: Upon the Architect's approval of the Pressure Test, the Contractor shall locate main lines and lateral lines and transfer that information onto the red-lined plan, to be passed along to the Consultant for final "As-Built" Record Document preparation. The Contractor shall provide that service at their cost or can request that the

Architect provide survey services (if agreed to by the Architect, in advance) before the backfilling of trenches can be completed.

C. Record Documents

1. The Contractor shall keep a current working set of drawings with all as-built changes or actual conditions as work proceeds, to be submitted to the Architect at completion of irrigation system installation.
2. Reserved
3. Contractor Redline Drawings
 - a. The "Redline" plans shall be reviewed and all features explained. The "as-built" plans shall consist of red-lined corrections, notes, comments, etc. on a clean bond paper copy. Any major deviations from the original Contract Documents shall be documented on the as-builts. All critical dimensions shall be shown.
 - b. The Architect shall review and approve the "as-built" plans submitted by the Contractor.
 - c. A complete Maintenance and Operations (M&O) Manual shall be prepared by the Contractor and shall be turned over to the Architect at the final inspection.
4. The Contractor shall provide the Architect with the necessary keys and/or other tools necessary to operate/drain/activate the system and spend sufficient time with the Architect to insure that the system operation/maintenance/winterizing can continue after departure of the Contractor. The Contractor shall be liable for all damage or loss resulting from failure to comply with the provisions of this paragraph.

J. Term of Warranty: The Contractor shall be responsible for all work showing defects in materials or workmanship, at no cost to the Owner, for a period of One Year from date of Substantial Completion or one year from date of de-winterization, whichever is latest. The Warranty shall include restoration of planted or paved areas due to settlement of trenches.

1. A final site meeting shall take place eleven months after the date of Substantial Completion or de-winterization, whichever is later. The system shall be examined by the Architect to determine if the system requires alterations or replacements.

END OF SECTION

SECTION 32 85 00 - LANDSCAPE GRADING

PART 1-GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Final grade topsoil for finish landscaping.

1.2 REFERENCES

- A. Specifications Division 31: Site Clearing, Earthmoving and Backfilling.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1.

1.4 SOURCE QUALITY CONTROL

- A. Topsoil Analysis: Furnish a soil fertility analysis of placed imported and/or on-site topsoil made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil. Submit soil analysis along with recommended soil amendment package to the Architect for review and approval prior to furnishing amendments.
- B. Refer to section 32 92 00 "Turf and Grasses" and section 32 93 00 "Plants" for soil amendment bid purposes.
- C. Finish grades shall be approved by the Landscape Architect prior to landscape installation.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate landscape grading work with landscape and irrigation work specified and in the Drawings. Refer to Architectural Plan for information regarding the date for turf sod and seed installation.

PART 2-PRODUCTS

2.1 TOPSOIL MATERIAL

- A. Topsoil Material: ASTM D 5268, pH range of 5.5 to 8.0, free of stones 1/2 inch or larger in any dimension, and other extraneous materials harmful to plant growth.
 - 1. Existing Topsoil Source: Excavate topsoil from surface per Division 31. Topsoil shall be fertile, friable, natural loamy sand, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, organic matter larger than 1/2 inch in any dimension, and other extraneous or toxic matter harmful to plant growth.
 - 2. Imported topsoil Source (if required): Import topsoil from off-site sources if on-site sources do not provide sufficient quantities. Provide new topsoil that is fertile, friable, natural loamy sand, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 1/2 inch in any dimension, and other extraneous or toxic matter harmful to plant growth. Contractor shall deliver to the site 10 CY of proposed imported topsoil or provide access to topsoil source for review and approval by Owner's Representative prior to placement. See paragraph 1.4 above for soil fertility testing requirements.
- B. All topsoil used on this project (stockpiled or import) shall meet the following criteria:
 - 1. pH: 5.5 - 8.0
 - 2. EC (electrical conductivity): <2.0 mmhos per centimeter
 - 3. SAR (sodium absorption ratio): <3.0

4. % OM (percent organic matter): ≥2%
5. Texture (particle size per USDA classification):
 - a. Sand:..... <70%
 - b. Clay:..... <30%
 - c. Silt: <70%
6. Stone Fragments (gravels or any soil particle greater than one half (1/2) inch in size): <5% (by volume)
7. Rocks Present > 1.5" None

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify trench backfilling have been inspected.
- B. Verify substrate base has been contoured and compacted to design grades per the plans.
- C. Beginning work of this section means acceptance of rough grading and subsoil conditions.

3.2 PREPARATION

- A. Ensure subgrade is acceptable for placement of topsoil.
 1. Eliminate uneven areas and low spots.
 2. Remove debris, roots, branches, stones, in excess of 1 inch in size from the surface. Remove topsoil contaminated with petroleum products.
 3. Scarify subgrade to depth of 4 inches where equipment has compacted the subsoil.

3.3 EXECUTION

A. TOPSOIL FILL

1. Place approved topsoil in areas where required to obtain thickness as scheduled. Place topsoil during dry weather.
2. Scarify sub-grade material prior to topsoil placement.
3. Topsoil stockpile shall sorted and/or screened to meet material requirements prior to placement.
4. Topsoil shall not be placed while in a frozen or muddy condition.
5. Topsoil that does not meet the required material specification shall not be placed on-site.
6. Grade topsoil to smooth, even surface with loose, uniformly fine texture. Remove ridges and fill depressions, as required to meet finish grades. Finish grade of topsoil shall be:
 - a. Sod Areas – 2 inch below top of adjacent pavement, valve box, vault, etc.
 - b. Seed Areas – 1 inch below top of adjacent pavement, valve box, vault, etc.
 - c. Planter Bed Areas – 3 inches below top of adjacent pavement, valve box, vault, etc.
7. Remove roots, weeds, rocks and foreign material prior to spreading, and remove from site.
8. Manually spread topsoil close to existing plant life and paving to prevent damage.
9. Compact topsoil to 85% relative density per ASTM D 698 at the following minimum thickness as required to achieve design grades:
 - a. Sod Areas: 8 inches minimum.
 - b. Seed Areas: 10 inches minimum.
 - c. Planter Bed Areas: 24 inches minimum.
10. Remove and dispose of surplus topsoil from the site.
11. Leave site clean and raked, ready to receive landscaping soil amendments.
- B. Remove roots, weeds, rocks, and foreign material from surface, and remove from site.
- C. Tolerances: Top of Topsoil - Plus or minus 1/4 inch.

3.4 PROTECTION

- A. Protect landscaping and other features remaining as final work.
- B. Protect existing structures, fences, sidewalks, and paving.
- C. Provide Dust Control in compliance with City of Richland and Benton County Requirements.

3.5 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

END OF SECTION 32 85 00

SECTION 32 92 00 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes Base Bid as noted in project drawings.
 - 1. Soil Preparation, amendment and fertilization
 - 2. Turf Sodding
 - 3. Turf Seeding
 - 4. Maintenance
 - 5. Clean-up
- B. Definitions
 - 1. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, Brome Grass, Black Henbane, Buffalobur, Common Crupina, Dalmatian Toadflax, Diffuse Knapweed, Dyer's Woad, Eurasian Watermilfoil, Field Bindweed, Hoary Cress, joined Goatgrass, Leafy Spurge, Matgrass, Meadow Hawkweed, Meadow Knapweed, Milium, Musk Thistle, Orange Hawkweed, Perennial Pepperweed, Perennial Sowthistle, Poison Hemlock, Puncturevine, Purple Loosestrife, Russian Knapweed, Scotch Broom, Scotch Thistle, Silverleaf Nightshade, Skeletonleaf Bursage, Spotted Knapweed, Syrian Beancaper, Toothed Spurge, Yellow Starthistle, Yellow Toadflax.
 - 2. Finish Grade: Elevation of finished surface of planting soil.
 - 3. Planting Soil: Imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
 - 4. Topsoil: Material per specifications section 32 85 00.
 - 5. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.
- C. Related Sections include the following:
 - 1. Specification Section 310000 Earthwork
 - 2. Specification Section 311100 Clearing and Grubbing.
 - 3. Specification Section 328500 Landscape Grading

1.2 REFERENCES

- A. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of Grass Seed: From seed vendor for each grass-seed blend or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
- C. Submit sod certification for grass species and location of sod source.
- D. Submit written certification on sod soil layer, see 2.2, B. 3. this section.
- E. Soil fertility testing data and proposed soil amendment data per section 32 85 00 1.4.
- F. Qualification Data: For landscape Installer.
- G. Maintenance Data
 - 1. Submit under provisions of Division 1.
- H. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer; and herbicide.

1.4 QUALITY ASSURANCE

- A. Seed: Provide seed mixture in containers showing percentages, year of production, net weight, date of packaging, and location of packaging.
 - B. Sod:
 - 1. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 - 2. Qualifications: Sod Producer shall be company specializing in sod production and harvesting with minimum five years of experience, and certified by the State of Washington.
 - C. Regulatory Requirements
 - 1. Comply with regulatory agencies for fertilizer and herbicide composition.
 - D. Installer Qualifications (Firm): In order to qualify for the landscape installation work on this project, the following information must be submitted with the Bid Submittal.
 - 1. A signed statement of experience certifying a minimum of five (5) years in business and describing in detail, experience in the installation of a minimum of three (3) projects of similar nature and scope.
 - E. Installer Qualifications (Individual): In order to qualify for the landscape installation work on this project, the following information must be submitted with the Bid Submittal.
 - 1. Landscape Installation/Maintenance Supervisor/Manager: This person shall have a minimum of three (3) years of experience in handling/maintaining the specified materials, and in sizes specified, in installations/maintenance of similar scope.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. Deliver, store, protect and handle products to site under provisions of Division 1.
 - B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Each variety of grass seed shall be tested seed from the latest crop available, and shall be delivered in standard sealed containers labeled in accordance with State and Federal laws. The label shall show the variety of seed, the percentage of germination, purity and weed content. All varieties of grass seed shall have a minimum tested germination of 95% and contain a minimum of 95% pure seed by weight.
 - C. Sod
 - 1. Deliver sod on pallets, in rolls. Protect exposed roots from dehydration.
 - 2. Do not deliver more sod than can be laid within 24 hours.
 - D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- 1.6 PROJECT/SITE CONDITIONS
- A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 100 degrees F.
- 1.7 SEQUENCING AND SCHEDULING
- A. Coordinate work under provisions of Division 1.
 - B. Coordinate landscape installation work with irrigation work specified and in the Drawings. Refer to Architectural Plans for information regarding the date for turf sod/seeding installation.
- 1.8 EXTENDED WARRANTY
- A. Provide one-year warranty under provisions of Division 1. Warranty includes coverage for one continuous growing season; replace lawn (seed or sod) that is dead, unhealthy or in an unsightly condition.
- 1.9 MAINTENANCE
- A. Seeded Lawn:
 - 1. Maintain seeded areas immediately after placement until grass is uniform and well established, full with no bare spots and exhibits a vigorous growing condition.
 - 2. Seeded lawn areas will not be accepted as substantial completion until a healthy, full, uniform stand of grass with no bare spots has been obtained.

- B. Sodded Lawn:
 - 1. Maintain sodded areas immediately after placement until date of Substantial Completion.

1.10 GUARANTEE AND REPLACEMENT

- A. All plant material and other materials installed under the Contract shall be guaranteed until Final Acceptance against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Owner's Representative, shall be replaced by the Contractor at his expense. Refer to Part 1.8 of this section for additional requirements.
- B. Any materials found to be dead, missing, or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Owner's Representative shall be the sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Owner. All replacement materials and installations shall comply with the Plans and Specifications. Refer to Part 1.8 of this section for additional requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS - NOT USED.

2.2 MATERIALS

- A. General: Refer to and coordinate with section 32 85 00 "Landscape Grading" for topsoil source, soil fertility testing and amendment requirements.
- B. Seed Mixtures: Seed shall be weed free, fresh, re-cleaned, Grade A, new crop consisting of the percentages of blend as specified. Seed shall be labeled in accordance with the U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act presently in effect.
 - 1. Turf Seed Blend:
 - 40% ChipShot Perennial Ryegrass
 - 30% Parkland Kentucky Bluegrass
 - 15% Super Blue Kentucky Bluegrass
 - 15% Baron Kentucky Bluegrass
- C. Seed shall be provided from and mixed by a certified dealer. Seed mixture shall be labeled with manufacturer's guaranteed analysis, germination rate and purity rate.
- D. Turf Sod: ASPA Certified Field grown grade; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sf. Sod shall be from an established local grower. The following is a pre-approved source:
 - 1. Ideal Sod, 2951 E. Foster Rd, Pasco, WA 99301 (509) 547-5222, (800) 627-4051, www.ideosod.com, or approved equal.
 - 2. Sod shall be Basin Sod Seed Mix Blue Rye Blend, available from Simplot Jacklin Seed Division, or approved equal.
 - 3. Sod soil layer shall not be a soil type which would inhibit the percolation of water to less than 2.4" per hour. Provide written certification from Sod Grower that this requirement is met.
- E. Soil Amendment: Compost
 - 1. Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from agricultural, food, or industrial residuals; bio solids (treated sewage sludge); yard trimmings or source-separated or mixed solid waste. The product shall contain no substances toxic to plants, will possess no objectionable odors and shall not resemble the raw material from which it was derived.
 - 2. Compost shall meet the following parameters:
 - a. pH: 5.0 – 8.5

- b. Soluble salt concentration: max. 10
 - c. Moisture content: 30-60% (wet weight basis)
 - d. Organic matter content: 30-65% (dry weight basis)
 - e. Particle size: 98% pass through 1/2" screen or smaller
 - f. Physical contaminants (inerts): less than 1%
- 3. Compost shall be measured by the cubic yard at the point of loading.
- F. Soil Amendment: Fertilizer
 - 1. Dolomitic Limestone.
 - 2. Elemental Sulfur 90%: Tiger 90CR Sulphur or approved equal.
 - 3. Soil Amendment NPK Fertilizer: 11-52-0 MAP fertilizer, or approved equal.
- G. Soil Amendment: Turf Starter Fertilizer
 - 1. Turf Starter NPK Fertilizer: 16-20-0 14S, or approved equal.
- H. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
- I. Weed Control Herbicide: Approved broad-leaf weed killer.
- J. Turf maintenance Fertilizer: NPK: 16-16-16, Loveland Products Inc. or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared topsoil is ready to receive the work of this Section.
- B. Beginning of installation means acceptance of existing site conditions.
- C. All planting areas shall be weed free at the time of seeding or sod installation.

3.2 EXECUTION

- A. Soil Amendments: After approximate finished grades have been established soil shall be conditioned and fertilized in the following manner. Soil amendments shall, at the following rate, be uniformly spread and cultivated thoroughly by means of mechanical tiller into the top soil layer; minimum four (4) inch depth and maximum six (6) inch depth. Application Rates:
 - 1. Dolomitic Limestone - 350 lbs. per acre.
 - 2. Elemental Sulfur 90% - 350 lbs. per acre.
 - 3. NPK 11-52-0 MAP Fertilizer - 200 lbs. per acre.
 - 4. Commercial grade compost - 1 cubic yard per 1000 square feet.
- B. Soil Amendments Turf Starter: Final operation just prior to laying sod apply turf starter fertilizer to the amended soil surface and work into the soil surface with the final grading and soil firming operation. Application Rates:
 - 1. NPK 16-20-0 14S - 200 lbs. per acre.
- C. Turf Sod:
 - 1. Moisten prepared surface immediately prior to laying sod.
 - 2. Lay sod immediately after delivery to site to prevent deterioration.
 - 3. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
 - 4. Lay smooth. Align with adjoining grass areas.
 - 5. Place top elevation of sod 1 1/2 inches below adjoining edging paving, curbs and sidewalks.
 - 6. On 3:1 or greater slopes, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
 - 7. Water sodded areas immediately after installation. Saturate sod to 4-inch depth.
 - 8. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roller not to exceed 100 lbs.
- D. Turf Seeding:
 - 1. Top elevation of seed 1 inch below adjoining edging, paving, curbs and sidewalks.
 - 2. Do not sow immediately following rain or when ground is too dry. Temperature

shall be between 55° F and 95° F for a 24-hour period. Wind shall be less than 20 mph.

3. Turf Seed shall be sown at the following rates;
 - a. Turf Seed: 8.5 lbs. per 1000 Square Feet
4. Seed shall be hydroseeded.
 - a. Hydroseed: Mix specified seed, mulch and water, using equipment specified designed for hydroseed application. Apply slurry uniformly to all areas to be seeded. Apply water with a fine spray immediately after each area has been mulched. Saturate the top 4 inches of soil.

E. Fertilizing:

1. Apply turf maintenance fertilizer (NPK 16-16-16) in accordance with manufacturer's instructions. Apply on day 40 and at date of substantial completion or day 85, whichever comes first.

F. Placement and tilling of soil amendments listed in this section must be observed and approved by the landscape architect prior to installation of sod. Contact landscape architect a minimum of 48 hours in advance of placement of amendments. Contractor shall photo document installation of all soil amendments and provide product receipts for all products specified for installation in this section.

3.3 MAINTENANCE

A. Maintenance shall be according to the following standards. All areas shall be mown, weeded and cultivated at intervals of not more than seven (7) days. Watering, trash and debris removal, mowing, rolling, edging, trimming, fertilization, spraying and pest control, as required, shall be included in the maintenance period. Cleaning of street gutters and sidewalks shall be included. The Contractor shall be responsible for maintaining adequate protection of the area. Damaged areas shall be repaired at the Contractor's expense. The Contractor shall reseed/resod all spots or areas within the lawn where normal turf growth is not evident.

B. Turf Care

1. Mowing will be contractor's responsibility until date of Substantial Completion.
2. Grass clippings shall be picked up and removed from the site.
3. Edges shall be trimmed at least twice monthly or as needed for neat appearance. Clippings shall be removed from paved areas and planting areas and removed from the site.
4. Lawn areas shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy stands of turf.
5. Roll surface to remove minor depressions or irregularities.
6. Control growth of weeds. After lawn has been mowed at least three times, apply a broad-leaf weed killer. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
7. **Immediately** reseed areas which show bare spots. Provide a uniform 100% coverage of thick, healthy stand of grass, full with no bare spots and exhibits a vigorous growing condition.
8. If seeded after September 15, continue maintenance to the following spring until acceptable lawn is established.

C. Continuously maintain the entire project area during the progress of work until date of Substantial Completion.

3.4 CLEANING

A. After all sodding operations have been completed, remove all trash and excess soil or rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site, once a week, and/or the last working day of each week. All

trash shall be removed completely from the site. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition acceptable to the Owner and Construction Manager.

3.5 PROTECTION

- A. Protect sodded/seeded areas with warning signs during maintenance period.

3.6 WARRANTY

- A. Contractor shall warrant work as provided by the General and Supplementary Conditions and Division 01 Specifications.

END OF SECTION 32 92 00

DIVISION 33– UTILITIES

Section 33 05 16	Utility Structures	3
Section 33 08 00	Utilities Commissioning	2
Section 33 11 16	Site Water Utility Distribution Piping	4
Section 33 31 00	Sanitary Utility Sewage Piping	3
Section 33 41 00	Storm Utility Drainage Piping	3
Section 33 46 16	Field & Track Subsurface Drainage	5
Section 33 46 23	Field & Track Permeable Aggregate.....	7

SECTION 33 05 16 - UTILITY STRUCTURES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular precast concrete manhole sections, catch basins, nyloplast drainage structure, utility vaults, water meter boxes, and all associated accessories.

1.2 REFERENCES

- A. ACI (American Concrete Institute) 318 - Building Code Requirements for Reinforced Concrete.
- B. ASTM A48 - Gray Iron Castings.
- C. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- D. ASTM C497 - Test Method for Concrete Pipe, Manhole Sections, or Tile.
- E. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
- F. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
- G. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge and Municipal Construction 2020 and amendments to date, English edition (WSDOT Standard Specifications).
- H. Latest edition of the City of Richland Standard Specifications and Drawings.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate manhole, catch basin, vault and box size, elevations, sumps, piping sizes and elevations of penetrations.
- B. Product Data: Submit manhole covers, component construction, features, configuration, dimensions and accessories.
- C. Manufacturer's Certificate: Submit Certificate of Compliance for manholes, catch basins, nyloplast drainage structure, vaults, boxes and accessories meet the requirements.
- D. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utility structures by horizontal dimensions, rim and invert elevations.
- B. As-Built Survey: At substantial completion, prepare an as-built survey of the utility structures to include the following: catch basins, storm drainage manholes, sanitary sewer manholes, cleanout assemblies, vaults and other associated utility structures. Survey shall be on the same project horizontal and vertical datum as noted on the construction documents. Provide rim and invert elevations for all sewer and storm drainage structures. Provide rim and utility structure location for all other utility structures.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's instructions for unloading, storing, lifting, and moving precast manholes, vaults and drainage structures.
- B. Store precast structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

PART 2 PRODUCTS

2.1 MANHOLES, CATCH BASINS AND WATER QUALITY STRUCTURES

- A. Storm Drain Manhole 48-60 inch diameter as shown on Drawings.
- B. On-Site Catch Basins: Catch Basins as shown on Drawings.

- C. Nyloplast Drainage Structure as shown on Drawings or approved equal.
- D. Sanitary Sewer Manholes: In accordance with the latest edition of the City of Richland Standard Specifications and Details.

2.2 FRAMES, COVERS, AND COMPONENTS

- A. Manhole Lid and Frame: ASTM A48, Class 30B cast iron construction, solid cover surface, removable lid, with identifying lettering: "STORM", or "SEWER".
 - 1. Buried Manhole Lid and Frame: Shall be non-corrosive composite material and shall be suitable for AASHTO HS-20 loading. Grade rings shall be polymer.
- B. Catch Basin Cover and Frame: As shown on Drawings.
- C. Manhole Steps: Formed, ½-inch deformed reinforcing bar polypropylene covered rung or approved equal. Formed integral with manhole and vault sections.
- D. Base Pad: Cast-in-place concrete or precast.
- E. Adjustment Rings: Concrete adjustment rings commercially available.
- F. Utility Vaults: In accordance with the manufacturer's guidelines and recommendations.
- G. Water Meter Boxes: In accordance with the City of Richland Standard Specifications and Drawings and as shown on Drawings.
- H. Nyloplast Grate and Frame: In accordance with the manufacturer specifications and as shown on Drawings.
 - 1. Grates shall be pedestrian style.

2.3 PRECAST UTILITY VAULTS AND WATER METER BOXES

- A. Water Meter Boxes: Per City of Richland Standard Specifications and Drawings.
- B. Utility Vaults: Per manufacturer specifications and requirements as noted in the drawings.
 - 1. All vaults shall be designed to site soil conditions and H-20 traffic loads.
 - 2. All vaults shall be designed to be watertight.
- C. All utility vaults shall have an accessible manhole frame and lid with a minimum of 24-inches in diameter.
- D. All utility vaults shall have cast in place ladder.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes, catch basins, water quality structures, vaults and boxes are correct.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

- A. Excavation and Backfill:
 - 1. Excavate for manholes, catch basins, nyloplast drainage structure, water quality structures, vaults and boxes in accordance with Section 31 2300 in location and to depth shown on Drawings.
 - 2. Backfill and compact to contours shown on Drawings. Back fill material in accordance with Section 31 2300 and as shown on Drawings.
 - 3. When groundwater is encountered, prevent accumulation of water in excavations. Provide and maintain sufficient pumping equipment for removal of groundwater when encountered during excavation. Place manholes or drainage structures in dry trench.

- B. Place base pad and trowel top surface level for catch basins, manholes, and water quality structures.
 - C. Install manholes, catch basins, nyloplast drainage structure, water quality structures, vaults and boxes supported at proper grade and alignment on compacted base.
 - D. Backfill and compact excavations and imported fill for manholes, catch basins, water quality structures, vaults and boxes in accordance with Section 31 2300 and as shown on drawings.
 - E. Install manholes, catch basin, nyloplast drainage structure, water quality structures, vaults and boxes plumb and level, to correct dimensions and elevations.
 - F. Install manholes, catch basin, nyloplast drainage structure, water quality structures, vaults and boxes plumb and level as per manufactures guidelines and recommendations.
 - G. Verify manholes, catch basins, nyloplast drainage structure, water quality structures, vaults and boxes installed satisfy required alignment and grade.
 - H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space per City of Richland Standard Drawings and Specifications.
 - I. Cut pipe to finish flush with interior of structure.
 - J. Set cover frames and covers level without tipping.
- 3.4 CASTINGS INSTALLATION
- A. Set frame and cover in accordance with the City of Richland Standard Specifications minimum and maximum height adjustments.
 - B. Covers shall be flush with finished graded unless otherwise noted.
- 3.5 FIELD QUALITY CONTROL
- A. Request inspection prior to placing manholes, catch basins, vaults and backfill against structures and over pipe.
 - B. Compaction Testing: In accordance with ASTM D1557, and ASTM D6938.
 - C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
 - D. Frequency of Tests: Test shall be taken per each structure at the following increments:
 - 1. At base of each structure.
 - 2. Increments of 2 feet vertical depth thereafter or finished subgrade whichever is lower.

END OF SECTION 33 0516

SECTION 33 08 00 UTILITIES COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

- A. The purpose of this section is to describe the commissioning process specific for those sections found in Division 33.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. General Responsibilities: The Contractor's commissioning responsibilities applicable to each of the Utilities contractors are as follows:
 - 1. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - 2. Attend a commissioning kick-off meeting and other meetings necessary to facilitate the Commissioning process.
 - 3. Contractors shall assist in clarifying the installation, operation, maintenance, and control of commissioned equipment if requested by the Commissioning Authority.

1.3 COORDINATION

- A. Refer to Section 01 91 13 for a listing of all sections where commissioning requirements are found, for systems to be commissioned and for functional testing requirements.

1.4 SUBMITTALS

- A. General Submittals: Contractor shall provide to the Commissioning Authority, through established channels, normal cut sheets and shop drawing submittals, and manufacturer's installation and start-up checklists, for all commissioned equipment.

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 SYSTEM STARTUP

- A. Installation Checklists: The Contractor shall complete the checklist(s) provided using the Facility Grid app.
 - 1. The completion of these checklists does not limit the Contractor's responsibilities for quality control and scheduling as indicated elsewhere in the documents, nor does this checklist include all submittal, inspection, or quality assurance requirements for the work of this Section.
- B. Pre-Verification Testing (PVT): The Contractor will perform the Pre-verification tests as provided with the Facility Grid app. When all pre-verification testing has been completed, the CA will schedule Functional Performance testing and substantial completion may be issued.

3.2 CLOSEOUT ACTIVITIES

- A. Training: The Owner personnel shall be trained on procedures related to the following:

1. Review with Owner's staff the "As Built" Drawings showing where main lines run, shut off valves are located and other site related maintenance items can be found.
2. Review the Operations and Maintenance Manuals and discuss with the Owner's staff maintenance for the items listed in 1.1A above.

3.3 DOCUMENTS REQUIRED

- A. The General Contractor will provide the following documentation before Final Acceptance:
 1. Copy of Completed Installation Checklists
 2. Completed Inspection Forms with approval signatures of all Authority Having Jurisdiction.

END OF SECTION

SECTION 33 11 16 - SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes pipe and fittings for site water line including domestic water lines, valves, and water services.

1.2 REFERENCES

- A. ASTM B 88M - Seamless Copper Water Tube Type K.
- 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 D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (shallow depth).
- D. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- E. AWWA C111 - Rubber- Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- F. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- G. AWWA C500 - Gate Valves, 3 through 48 in NPS, for Water and Sewage Systems.
- H. AWWA C502 - Dry Barrel Fire Hydrants.
- I. AWWA C504 - Rubber Seated Butterfly Valves.
- J. AWWA C509 - Resilient Seated Gate Valves 3-in through 12-in NPS, for Water and Sewage Systems.
- K. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- L. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings
- M. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inch through 60-inch.
- N. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge, and Municipal Construction, 2020, English edition and amendments to date (WSDOT Standard Specifications).
- O. Latest edition of the City of Richland Standard Drawings and Specifications.
- P. 2014 Safe Drinking Water Act.
- Q. NSF/ANSI 61 - Drinking Water System Components - Health Effects

1.3 SUBMITTALS

- A. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- C. Certification that pipe, fittings, and appurtenances meet NSF 61.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- C. As-Built Survey: At substantial completion, prepare an as-built survey of the actual locations of the piping mains, valves, and accessories. Survey shall be on the same project horizontal and vertical datum as noted on the construction documents.
- D. Backflow Assemblies: Provide certified backflow test reports to the City of Richland Cross Control Specialist.

1.5 QUALITY ASSURANCE

- A. Install pipe, fittings, and accessories in accordance with Section 7-09 of the WSDOT Standard Specifications and the City of Richland Standard Specifications. Where Specifications conflict; City of Richland Standard Specifications shall prevail. Perform Work in accordance with ASTM, AASTHO and local governing procedure standards.

- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. All wetted materials, including rubber, plastic, interior linings and coatings, adhesives, lubricants, etc. of the potable water system (pipes, pipe fittings, valves, etc.) shall be lead free and meet the requirements of NSF Standard 61 (2014 Safe Water Drinking Act).

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 WATER PIPE

- A. Ductile Iron Pipe: AWWA C151, Class 50
 - 1. Fittings and Joints: In accordance with the requirements of the City of Richland Standard Specifications.
- B. Polyvinyl Chloride (PVC): ANSI/AWWA C900, SDR 18
 - 1. Fittings and Joints: Shall be the same as specified for Ductile Iron Pipe.

2.2 VALVES – 2 INCH THROUGH 8 INCH

- A. Gate Valves: AWWA C509, resilient wedge type meeting the Requirements of City of Richland Standard Specifications. Accepted manufactures in accordance with the City of Richland Standard Specifications.
- B. Fittings and Joint Material: Meeting the requirements of City of Richland Standard Specifications.
- C. Soft Seat Check Valve: In accordance with the City of Richland Cross-Control requirements.

2.3 WATER SERVICES AND WATER METERS

- A. Cut-In-Tees: Meeting the requirements of City of Richland Standard Specifications and Drawings.
- B. Water Service Line and Assembly: Meeting the requirements of City of Richland Standard Specifications and Drawings.
- C. Water Meter Assembly and Box: Meeting the requirements of City of Richland Standard Specifications and Drawings.
- D. Double Check Valve Assembly (DCVA): In accordance with the City of Richland Standard Specifications and Drawings.

2.4 MISCELLANEOUS ACCESSORIES AND MATERIALS

- A. Cement Concrete for Thrust Blocks: Commercially available; class 3000 meeting the requirements of the City of Richland Standard Specifications.
- B. Restraint Joint Devices: Meeting the requirements of the City of Richland Standard Specifications.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding: Trench excavated materials as approved by Engineer meeting the requirements of the City of Richland Standard Specifications. All imported pipe bedding to meet the requirements of the City of Richland Standard Specifications or as approved by the Engineer.
- B. Cover: Backfill, as specified in Section 31 2300.

2.6 PIPE LOCATOR RIBBON

- A. Pipe locator ribbon shall be in accordance with the City of Richland Standard Specifications.

2.7 TRACER WIRE

- A. Tracer Wire shall be in accordance with the City of Richland Standard Specifications.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.
- 3.2 PREPARATION
 - A. Prepare all pipe and fitting in accordance with City of Richland Standard Specifications.
 - B. Contractor to pay all City of Richland connection and Cut-in fees. Notify City of Richland a minimum of 10 working days to schedule water main cut-in.
- 3.3 BEDDING
 - A. Excavate pipe trench in accordance with Section 31 2300 and Section 7-09 of the WSDOT Standard Specifications.
 - B. Place bedding material in accordance with the City of Richland Standard Specifications and Section 7-09.3(9) of the WSDOT Standard Specifications.
 - C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.
 - D. Maintain optimum moisture content of fill material to attain required compaction density.
- 3.4 INSTALLATION - PIPE
 - A. Maintain ten (10) feet horizontal separation of water main from sanitary sewer piping.
 - B. Install pipe in accordance with the City of Richland Standard Specifications and Section 7-09 of WSDOT Standard Specifications. Where Specifications conflict the City of Richland Standard Specifications shall prevail.
 - C. Connect to existing waterline stubs as indicated on Drawings.
 - D. Form and place concrete for thrust restraints in accordance with the requirements of City of Richland Standard Drawings and Specifications.
 - E. Backfill trench in accordance with Section 31 2300.
- 3.5 INSTALLATION - VALVES
 - A. Install valves in accordance with City of Richland Standard Specifications.
 - 1. Water valve boxes located off-site and in the farmed field shall be buried as shown in the Drawings.
- 3.6 INSTALLATION – TRACER WIRE
 - A. Install tracer wire per City of Richland Standard Drawings and Specifications.
- 3.7 INSTALLATION – PIPE LOCATOR RIBBON
 - A. Install pipe locator ribbon in accordance with City of Richland Standard Specifications.
- 3.8 DISINFECTION AND FLUSHING OF DOMESTIC WATER PIPING SYSTEM
 - A. Disinfect and flush system in accordance with City of Richland Standard Specifications.
- 3.9 WATER MAIN TIE-INS
 - A. Connect to existing City water system with tapping sleeve in accordance with City of Richland Standard Specifications and Drawings.
 - B. Coordinate Work with City of Richland.
 - C. Contractor to excavate and expose water main at tie-in location.
 - D. Contractor to construct thrust block and backfill and compact location after cut-in tee is installed.
 - E. Contractor to repair roadway cut in accordance with City of Richland Standard Specifications and Drawings.
 - F. Contractor shall provide traffic control as required by the City of Richland.
- 3.10 SERVICE CONNECTIONS
 - A. Install water service of size and type as indicated on Drawings and in accordance with City of Richland Standard Specifications and Drawings.

- B. Contractor to repair roadway cut in accordance with City of Richland Standard Specifications and Drawings.
 - C. Contractor shall provide traffic control as required by the City of Richland.
 - D. Install DCVA on water services downstream of City meter in accordance with the City of Richland Standard Specifications and Drawings.
 - 1. City of Richland Cross Control Specialist shall inspect installation prior to burying pipe. Contractor shall coordinate inspection with the City.
 - 2. Provide backflow tests by a certified backflow assembly tester.
- 3.11 SCHEDULE
- A. Install off-site water improvements per the timeframes as shown on the Drawings.
- 3.12 FIELD QUALITY CONTROL
- A. Compaction Testing: In accordance with ASTM D1557, and ASTM D6938.
 - B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
 - C. Frequency of Tests: In accordance with Section 31 2300.
 - D. Bacteriological Tests: Tests to be performed in accordance with City of Richland Standard Specifications.
 - E. Hydrostatic Tests: Conduct tests in accordance with City of Richland Standard Specifications. Repair defective joints or pipe until the leakage of a subsequent test is within the specified allowance.
 - F. Provide backflow assembly tests by a certified backflow assembly tester. Test shall be passing. Repair work until test is passing. Submit passing test results to the City of Richland Cross Control Specialist.

END OF SECTION 33 1116

SECTION 33 31 00 - SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes sanitary sewerage drainage piping, fittings, accessories and bedding; and connection of building sanitary drainage system to municipal sewers system.

1.2 REFERENCES

- A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 inch Drop.
- B. ANSI/ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- C. ANSI/ASTM D3034 – Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
- D. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (shallow depth).
- E. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge, and Municipal Construction, 2020, English edition and amendments to date (WSDOT Standard Specifications).
- F. Latest edition of the City of Richland Standard Drawings and Specifications.

1.3 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.4 SUBMITTALS

- A. Product Data: Submit data indicating pipe and pipe accessories.
- B. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record location of pipe runs, connections, manholes cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- C. As-Built Survey: At substantial completion, prepare an as-built survey of the actual locations of the piping runs, connections, manholes, cleanouts and rim and invert elevations. Survey shall be on the same project horizontal and vertical datum as noted on the construction documents.

1.6 COORDINATION

- A. Coordinate the Work with termination of sanitary sewer connection outside building and connection to municipal sewer utility service.

PART 2 PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. Gravity Sanitary Sewer: Less than 15-foot cover: ANSI/ASTM D3034, SDR 35; size as shown on Drawings, bell and spigot style with rubber gasket.
- B. Gravity Sanitary Sewer: Less than 4-ft cover: Polyvinyl Chloride (PVC): ANSI/AWWA C900, SDR 18
 - 1. Fittings and Joints: Shall be the same as specified for Ductile Iron Pipe.

2.2 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.3 BEDDING AND COVER MATERIALS

- A. Bedding: Crushed surfacing top course meeting the requirements of Section 9-03.9(3) of the WSDOT Standard Specifications.
- B. Cover: Backfill as specified in Section 31 2300.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 2300 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material and compact in accordance with the City of Richland Standard Specifications.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with Section 7-17 of the WSDOT Standard Specifications and the City of Richland Standard Specifications. Where Specifications conflict the City of Richland Standard Specifications shall prevail.
- B. Lay pipe to slope gradients noted on drawings with maximum variation in accordance with the City of Richland Standard Specifications.
- C. Refer to Section 31 2300 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- D. Refer to Section 33 0516 for manhole requirements.
- E. Provide sewer to within 5 feet from building line and connect to on-site sewer system.
- F. Sanitary sewer line end marker: 2-inch by 4-inch lumber pressure treated, top 2-feet painted green.

3.5 SCHEDULE

- A. Install the off-site sanitary sewer improvements per the timeframes as shown on the Drawings.

3.6 FIELD QUALITY CONTROL

- A. Request inspection prior to and immediately after placing bedding.
- B. Compaction Testing: In accordance with ANSI/ASTM D1557, and ASTM D6938.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: In accordance with Section 31 2300.
- E. Pressure Test (Gravity Sewer): Test in accordance with Section 7-17.3(2)F of WSDOT Standard Specifications.

3.7 PROTECTION OF FINISHED INSTALLATION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes site storm utility drainage piping, fittings and accessories.

1.2 REFERENCES

- A. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and 18-inch Drop.
- B. ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- C. ASSHTO M294 Type S – Specification for Corrugated Polyethylene Pipe, 12 to 36-Inch Diameter and Fittings.
- D. ASSHTO M252 Type S – Specification for Corrugated Polyethylene Pipe, 3 to 10-inch Diameter and Fittings.
- E. ASTM D1758 – Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- F. ASTM D1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Material.
- G. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (shallow depth).
- H. Washington State Department of Transportation and American Public Works Association Standard Specifications for Road, Bridge and Municipal Construction 2020 and amendments to date, English edition (WSDOT Standard Specifications).
- I. Latest edition of the City of Richland Standard Drawings and Specifications.

1.3 SUBMITTALS

- A. Product Data: Submit data indicating pipe and pipe accessories.
- B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.
- C. Manufacturer's Certificate: Submit Certificate of Compliance all pipe and pipe accessories meet the requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Accurately record actual locations of pipe runs, connections, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
 - 3. As-Built Survey: At substantial completion, prepare an as-built survey of the actual locations of the piping runs, connections, manholes, catch basins, cleanouts and rim and invert elevations. Survey shall be on the same project horizontal and vertical datum as noted on the construction documents.

1.5 COORDINATION

- A. Coordinate the Work with Building Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Storm Sewer Pipe Materials:
 - 1. As shown on Drawings.
- B. Roof Drain Pipe Material:
 - 1. Corrugated Polyethylene: AASHTO M 252, Type S, smooth wall interior, size as shown on Drawings.
 - 2. PVC Plastic Pipe: ASTM 3034, SDR 35, size as shown on Drawings.
- C. Infiltration Trench:

1. Piping: Pipe complying with ASSHTO M294 M74 PES for NPS 12 to NPS 48. Include proprietary fittings, couplings, seals and filter fabric.
2. Filtering Material: Gravel backfill for drywells per WSDOT Standard Specification 9-03.12(5).
3. Filter Fabric: Mirafi 140-N or approved equal non-woven polypropylene geotextile

2.2 ACCESSORIES

- A. Pipe Joints: Bell and spigot style rubber ringed sealed gasket joint.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps, end caps, and other configurations required.
- C. Storm Sewer Line End Marker: 2-inch by 4-inch lumber pressure treated the top 2-feet painted magenta.

2.3 BEDDING AND COVER

- A. Bedding: Trench excavated materials as approved by Engineer meeting the requirements of Section 7-08.3(1) of the WSDOT Standard Specifications. All imported pipe bedding to meet the requirements of Section 9-03.12(3) of the WSDOT Standard Specifications.
- B. Cover: Backfill, as specified in Section 31 2300.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavation base is ready to receive work and dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Remove large stones or other hard matter that could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 2300 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material and compact in accordance with Section 7-08.3(1) of the WSDOT Standard Specifications.
- C. Bedding for RCP shall be Type 2 per ASCE 15-98.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with Section 7-08.3(2) of the WSDOT Standard Specifications. Seal joints watertight.
- B. Refer to Section 31 2300 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- C. Refer to Section 33 0516 for manhole, drywell and catch basin requirements.

3.5 INSTALLATION – INFILTRATION TRENCH

- A. Install pipe, fittings, and accessories in accordance with Section 7-08.3(2) of the WSDOT Standard Specifications. Seal joints watertight.
- B. Refer to Section 31 2300 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- C. Refer to Section 33 0516 for manhole requirements.
- D. Protect washed drain rock from sediment contamination. No sediment allowed in washed drain rock.
- E. Install Filter Fabric in accordance with manufacture's guidelines, recommendations and as shown on Drawings. Overlap fabric a minimum of 18-inches.
 1. Do not place filter fabric at bottom of infiltration trench as shown on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Request inspection prior to and immediately after placing aggregate cover over pipe.
- B. Compaction Testing: In accordance with ASTM D1557 and ASTM D6938.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: In accordance with Section 31 2300.

3.7 PROTECTION OF FINISHED WORK

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
- B. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
- C. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION 33 4100

SECTION 33 46 16 FIELD & TRACK SUBSURFACE DRAINAGE

PART 1 - GENERAL

1.01 SCOPE OF WORK:

- A. Furnish and install complete subsurface drainage systems for synthetic turf fields, and perimeter areas as indicated on the drawings.
- B. Coordinate this work with that of Sections 31 00 00 Earthwork and 31 22 16 Field Subgrade Establishment.
- C. The work includes systems incorporating traditional Trenched Perforated Drainage Tubing and 12" width "flat" or "panel" type drainage tubing.
- D. Trench to line and grade as shown on the drawings utilizing laser controlled equipment.
- E. Dispose of excavated trench material.
- F. Collector Tubing:
 - 1. For non-perforated collector under 12" in diameter, install corrugated polyethylene (CPEP) collector tubing. Backfill with select site soil, 8" maximum lifts, compacted to 95%.
 - 2. For perforated collector, install corrugated polyethylene (CPEP) collector tubing. Bed and Backfill with pea gravel.
- G. Remove all loose material from collector and lateral trench bottom.
- H. For round pipe perforated lateral drainage piping, place a minimum 2" depth of specified washed pea gravel bedding for perforated lateral piping.
- I. Install perforated corrugated tubing lateral system plumbed to collector piping.
- J. Bed and backfill round perforated tubing trenches with specified washed pea gravel. Backfill over corrugated tubing in jump pits with pea gravel.
- K. Upon completion of this work, restore subgrade to specified condition and tolerances, compacted to 95% density with no loose material on surface.
- J. Furnish and install trench drain and trench drain catch basins around the perimeter of the playing field as shown on the plans.

1.02 STANDARD SPECIFICATIONS:

- A. American Public Works Association, Washington State Chapter, Standard Specifications for Municipal Public Works Construction (APWA) (latest edition).
- B. Standard Specifications for Road, Bridge, and Municipal Construction, WDOT, American Public Works Association (APWA)
- C. United States Department of Agriculture, Soil Conservation Service, Engineering

Standard 606.

1.03 RELATED WORK IN OTHER SECTIONS:

- 31 20 00 Earth Moving
- 31 22 16 Field & Track Subgrade Establishment
- 33 34 05 Field & Track Storm Drainage
- 33 46 23 Field Permeable Aggregate

1.04 SUBMITTALS:

- A. Submit to the Field Landscape Architect for approval:
 - 1. Pea gravel sieve analysis
 - 2. Product data for perforated and non-perforated tubing
 - 3. Product data for all fittings and connections

1.05 QUALIFICATIONS:

- A. The Contractor (or Subcontractor) responsible for field base establishment, field subsurface drainage, and field permeable aggregate placement and compaction shall be submitted to the Field Landscape Architect for approval. Specific qualification recommendations are included as follows:
 - 1. Contractor shall be and has been actively and directly engaged in constructing similar natural or synthetic field projects for a period of five (5) or more years and shall provide proof of five (5) or more full size (minimum 75,000 SF) field base installations completed in the past five (5) years.
 - 2. The Contractor's experience shall include completion of high school or collegiate competition fields, or professional level practice or competition fields. The qualifying playing field systems shall include earthwork, washwater or irrigation systems, drainage and subsurface drainage systems and base aggregate placement and compaction.
 - 3. If so directed, provide a listing of all construction contracts (whether completed or in progress) entered into or performed by the Contractor within the past five years for projects similar in scope, time and complexity to the work called for under this Contract; include the names of the contracts, and the names and contact information of the owners.

PART 2 - PRODUCTS

2.01 PERFORATED AND NON-PERFORATED TUBING:

- A. The piping shall be corrugated polyethylene drainage tubing. The perforated and non-perforated collector tubing shall be smooth interior wall CPEP.
- B. Material shall conform to requirements of Type III, Grade 4, Class "C" polyethylene as specified in ASTM D1248.
- C. Dimensions:
 - 1. Inside diameter variance shall not exceed -0.0% or +5%.
 - 2. Lengths shall be in coiled configuration with a -0.0% tolerance.

- D. Tubing shall conform to U.S. Department of Agriculture Soil Conservation Service, Engineering Standard 606.
- E. Perforated tubing
 - 1. For round pipe, utilize single wall, perforated drainage tubing. Water inlet areas shall be slotted with a width of 1/16" "0.020" to a maximum of 3/32" "0.030" uniformly spaced circumferential slots located on the inner depression of the corrugation, totaling a minimum of 1.25 square inches per lineal foot. The perforations shall provide a clear opening. Tubing with perforations that are punched with a flap type opening or that are not uniform will be rejected.
 - 2. For Flat or Panel-type Drainage Tubing, ADS "AdvanEdge" system and all necessary pre-molded fittings, couplers, and caps.
- F. Fittings and Connections:
 - 1. Fittings shall be as furnished by the manufacturer of the pipe.
 - 2. Connections of tubing lengths shall be with split coupling or snap-in-type couplings utilizing polyethylene or construction tape.
 - 3. Tubing is to be inserted into sockets for the full socket length. "Slip-fit" connections will not be permitted.
 - 4. All split coupling connections are to be fully taped. All connections at fittings and connections are to be taped at interface of exposed joint.

2.02 PEA GRAVEL:

- A. Pea-gravel bedding and backfill for perforated pipe subdrainage systems, and as backfill for un-piped infiltration trenches, shall be clean, washed, uniformly graded 3/8" to 1/8". The pea gravel material graduation must meet the following sieve analysis:

<u>Sieve Size</u>	<u>Percent Passing</u>
1/ 2"	100
3/ 8"	80 - 100
# 4	0 - 50
# 8	0 - 10
# 100	0 - 0.6
# 200 (wet sieve)	0 - 0.5
# 270 (wet sieve)	0 - 0.3

2.03 TESTING:

- A. The Owner will be performing testing of materials delivered to the job site for the purpose of verifying compliance with the contract documents. The Owner's testing is for this purpose only and not for construction quality control by the Contractor.
- B. The Contractor shall coordinate directly with the Owner's testing firm relative to the delivery schedules of the imported materials.
- C. The Contractor shall provide testing and surveillance as required to assure materials and work fully comply with contract requirements.
- D. The Contractor at a price equal to the Owner's contract testing agreement shall pay for owner's tests that do not meet specifications. The Contractor shall pay directly to the testing organization upon invoice to the owner, which has been approved by the Field

PART 3 - EXECUTION

3.01 TRENCHING:

- A. Coordination: It is the responsibility of the Contractor to ensure that electrical conduits and wash water piping are installed at a sufficient depth below subgrade before the trenching for the subsurface drainage system to avoid conflicts between systems.
- B. Excavation shall be made to the alignment, elevation, grade and slope as indicated on the drawings.
- C. Trenching shall be accomplished utilizing equipment with slope and depth control, such as "Laser Plane Control System", so as to ensure accuracy in the bottom of the trench.
- D. No high points above designated invert or calculated trench bottom elevation will be permitted. No sloughing of site material or loose excavated soil will be permitted to remain in the trenches.
- E. Surplus excavated soil shall be removed from the field area. Excavated material may not remain on subgrade. Excess soil material shall be disposed of off-site or in District controlled site directly adjacent to the project work area.
- F. Provide a smooth, even subgrade after removal of the trench material. Subgrade to be compacted to 95% density. Leave no loose material on the subgrade.

3.02 PLACEMENT:

- A. Excavation below invert grade must be established to a depth so as to provide for specified placement of pea gravel bedding at bottom of pipe elevation prior to laying the tubing.
- B. Pea-gravel bedding for perforated pipe shall be clean, washed, uniformly graded 3/8" to 1/8".
- C. No foreign material will be permitted inside, alongside, under, or on top of, installed tubing.
- D. All joints and connections shall be with manufacturers snap type fittings and taped secure.
- E. Coordinate installation of structural soil bearing fabric to be continuous through trenches, however never placed over the surface of the pipe.
- F. For round pipe perforated lateral drainage piping, place a minimum 2" depth of specified washed pea gravel bedding for perforated lateral piping.

3.03 BACKFILL:

- A. The backfill for all round perforated pipe shall be clean washed pea gravel, uniformly graded 3/8" to 1/8".

- B. All trenches to have backfill material "crowned" a minimum of 2" above subgrade to protect from foreign material and provide for ease of location identification. Crowns with foreign material contamination shall be removed prior to placement of base aggregate.
- C. Specified bedding shall not be placed until Field Landscape Architect approves the trench.
- D. Trench backfill shall not be placed before Field Landscape Architect approves perforated pipe placement.
- E. During placement of specified trench backfill, pipe must be held in place with a hand device to prevent displacement and provide for achieving specified invert elevation. Do not damage pipe or allow pipe to be displaced by placement of backfill material.

3.04 CONNECTIONS:

- A. Includes all new work and connection to existing subdrainage pipe.
- B. All connections are to be made with approved fittings as recommended by the tubing manufacturer and approved by the Field Landscape Architect.
- C. Tubing is to be inserted into sockets for the entire length. Tape all connections utilizing polyethylene or construction tape. Tape alone shall not be acceptable when connecting separate pieces of pipe together.
- D. No foreign material will be permitted inside the installed tubing.
- E. Cap the ends of all lateral runs as shown on the drainage plan. All open ends during construction are to be temporarily capped or plugged. Tape shall not be used in lieu of end caps.
- F. Connection of laterals to collector drains shall be made with a combination reducing tee and reducing saddle tee or end tee as applicable, utilizing snap connections.

3.05 EQUIPMENT MOVEMENT:

- A. No trucks or equipment will be allowed to drive over the top of the trenches except track-equipped machinery utilized in spreading imported granular materials. Backfilled trenches are to be staked and "flagged" 3' above grade a maximum 20' spacing for identity.

END OF SECTION

SECTION 33 46 23 FIELD & TRACK PERMEABLE AGGREGATE

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Include all labor, material, transportation and services to complete installation of the permeable aggregate base and the permeable aggregate top course as shown on the drawings for the synthetic turf areas and permeable rubberized surfacing areas including:
 - 1. Final subgrade establishment
 - 2. Structural soil-bearing fabric
 - 3. Base course permeable aggregate
 - 4. Top course permeable aggregate
 - 5. Coordinate acceptance by Rubberized Surfacing and Synthetic Turf Contractors
 - 6. Pressure Treated Wood / Recycled Plastic Synthetic Turf Edge Anchor
- B. Related Work in Other Sections:
 - 31 20 00 Earth Moving
 - 31 22 16 Field & Track Subgrade Establishment
 - 33 34 05 Field & Track Storm Drainage
 - 33 46 16 Field & Track Subsurface Drainage

1.2 STANDARD SPECIFICATIONS

- A. Design Procedure and General Specifications, Asphalt Paving, Asphalt Pavement Association of Washington (APAW);
- B. American Public Works Associations, Washington State Chapter, Standard Specifications for Municipal Public Works Construction, (APWA), latest edition.
- C. American Standard Testing Materials, (ASTM);
- D. American Association of State Highway and Transportation Officials, (AASHTO).

1.3 SUBMITTALS

- A. Submit to the Engineer for approval:
 - 1. Structural fabric product data
 - 2. Base course permeable aggregate sieve analysis
 - 3. Base course permeable aggregate infiltration rate
 - 4. Top course permeable aggregate sieve analysis
 - 5. Top course permeable aggregate infiltration rate
 - 6. Equipment and procedures to be utilized for the permeable aggregate installation.

1.4 QUALIFICATIONS

- A. The subcontractor responsible for Outdoor Athletic Facilities Permeable Aggregate Base shall be submitted to the Engineer for approval upon request. Specific qualification recommendations are included as follows:
 - 1. Contractor shall be and shall have been actively and directly engaged in constructing similar natural or synthetic field, track, and court projects for a period of five (5) or more years under the current business name and shall provide proof of successful completion of the following Outdoor Athletic Facilities;
 - a. Five (5) or more full size (minimum 75,000 SF) synthetic or sand-based natural grass field subgrade installations completed in the past three (3) years
 - b. Three (3) or more full-sized (six x42" lane) 400-meter vertically-draining polyure-

- thane-surfaced track bases in the past five (5) years
2. The Contractor's experience shall include completion of high school, college, or professional level competition fields.
3. Other acceptable relevant work experience includes and base sand, root zone sand, or base aggregate placement and compaction for the relevant facilities-types listed.
4. Provide a listing of all construction contracts (whether completed or in progress) entered into or performed by the subcontractor within the past five years for projects similar in scope, time and complexity to the work called for under this Contract; include current Owner/Facility Manager contact information.

PART 2 PRODUCTS

2.1 PERMEABLE STRUCTURAL SOIL-BEARING FABRIC

A. Fabric

1. Material: Fabric to be 100% Polypropylene, non-woven, needle-punched engineering fabric with a minimum weight of 4.0 oz/sy.
2. Physical Properties:

Tensile Strength, lbs., (ASTM D-4632):	100
Elongation (%), (ASTM D4632):	50
Puncture Strength, (lbs), (ASTM D4833):	65
Mullen Burst Strength (PSI), (ASTM D3786):	200
Trapezoidal Tear, (lbs), (ASTM D4533):	45
Abrasion Res. % Str. Ret., (ASTM D4886):	80
Coefficient. of Perm., cm/sec., (ASTM D4491):	0.22
Flow Rate Gal./Min./Sq.Ft.) (ASTM D4491):	140
3. Material to be Northwest Linings (253) 872 0244, or approved equal.

2.2 BASE COURSE PERMEABLE AGGREGATE

- A. The base course permeable aggregate shall be installed below the top course permeable aggregate.
- B. Aggregate to be open-graded, fractured, friction course. To ensure free drainage, material to be clean with minimal fines. The compacted base course permeable aggregate shall demonstrate a minimum infiltration rate of 40 inches per hour when the material is compacted to a minimum density of not less than 98% of maximum dry density as determined by ASTM D698.
- C. Base course material to be a minimum of 75% fractured with at least one fractured face by mechanical means on each individual particle larger than 1/4". A sand and gravel source is acceptable for this material.
- D. Material Strength and Durability
 1. The material shall demonstrate a compressive strength sufficient to support the anticipated construction loading without significant breakage of individual particles, or significant alteration of the particle gradation as approved.
 2. Where the compressive strength is suspect, the Engineer will remove a sample of the material that has been placed by the Contractor at the specified density and perform a particle gradation, the results of which will be compared to previous production test results (approved baseline values). If the results of this test indicate higher passing values for any given screen exceeding 10% of the baseline, the material may be considered noncompliant.
- E. Gradation: Aggregate to meet the following particle size limitations:

Sieve Size	Percent Passing by Weight

1-1/4"	100
1"	90 - 100
3/4"	80 - 100
1/2"	50 - 80
3/8"	40 - 60
No. 4	15 - 40
No. 8	10-25
No. 30	5 - 15
No. 100	0-3.0
No. 200 (wet sieve)	0 - 2.0

2.3 TOP COURSE PERMEABLE AGGREGATE

- A. The top course permeable aggregate shall be installed above the base course aggregate.
- B. Aggregate to be open-graded, fractured, friction course. To ensure free drainage, material to be clean with minimal fines. The compacted top course permeable aggregate shall demonstrate a minimum infiltration rate of 20 inches per hour when the material is compacted to a minimum density of not less than 98% of maximum dry density as determined by ASTM D698.
- C. The top course material to be 100% fractured. A quarry source is required for this material.
- D. Material Strength and Durability
 - 1. The material shall demonstrate a compressive strength sufficient to support the anticipated construction loading without significant breakage of individual particles, or significant alteration of the particle gradation as approved.
 - 2. Where the compressive strength is suspect, the Engineer will remove a sample of the material that has been placed by the Contractor at the specified density and perform a particle gradation, the results of which will be compared to previous production test results (approved baseline values). If the results of this test indicate higher passing values for any given screen exceeding 10% of the baseline, the material may be considered noncompliant.
- E. Gradation: Aggregate to meet the following particle size limitations:

Sieve Size	Percent Passing by Weight
3/4"	100
1/2"	90-100
3/8"	70-90
No. 4	30-60
No. 8	20-40
No. 30	5-15
No. 100	2-5
No. 200 (Wet Sieve)	0-3.0
No. 270 (Wet Sieve)	0-1.5

Note: The material must comply with both the sieve and infiltration requirements.

2.4 SYNTHETIC TURF EDGE ANCHOR

- A. Include all materials required to provide a secure "nailer" edge for establishment of Permeable Aggregate grade and anchoring of synthetic turf. Contractor may select either Pressure Treated Wood Lumber or Recycled Plastic Lumber and a single anchoring method for uniform use throughout the work. For work performed when mean daily high temperatures can reasonably be expected to exceed 80°F, use pressure treated lumber.
- B. Recycled Plastic Lumber: A recycled plastic lumber nailer board shall be installed per the

details to secure the turf. Product shall be manufactured from 100% recycled materials, consisting of HDPE Plastic Lumber. Material should be dimensional lumber in lengths no shorter than 6'.

1. Where attachment is scheduled to concrete curbing, provide minimum 2"x4" nominal dimensional lumber.
2. Manufacturer's reference: Product is available from RESCO Plastics, Inc., Coos Bay, Oregon. (800) 266-5097.

C. Pressure Treated Wood Lumber.

1. Provide only straight, kiln dried lumber using waterborne preservatives Chromated Copper Arsenate (CCA-C), Alkaline Copper Quat (ACQ-C, ACQ-D, ACQ-D Carbonate), Micronized Copper Quat (MCQ), Copper Azole (CA-B & CA-C, μ CA-C) or Sodium Borates (SBX/DOT).
2. Minimum Retention Rates for Specific Compounds:
 - 0.15 pcf for ACQ,
 - 0.15 pcf for MCQ,
 - 0.10 for CA-B,
 - 0.06 pcf for CA-C and MCA
 - 0.05 pcf for μ CA-C

D. Concrete Anchoring: Concrete wedge anchor, zinc plated, 3/8" x5" length, partially threaded, with zinc plated washer and nut.

E. Steel power-load driven or ram-set Concrete Anchor Nail, minimum shank diameter 5/32", minimum head/washer diameter 3/8", sufficient length to insure a minimum 2" embedment. Individual anchors shall develop a minimum 450lb shear, 350lb tension in 4,000psi concrete at 2" embedment.

2.5 TESTING

- A. The Owner will perform testing of materials delivered to the job site for the purpose of verifying compliance with the contract documents. The Owner's testing is for this purpose only and not for construction quality control by the Contractor.
- B. The Contractor shall coordinate directly with the Owner's testing firm relative to the delivery schedules of the imported materials. Sampling will be scheduled each day deliveries occur.
- C. The Contractor shall provide testing and surveillance as required to assure materials and work fully comply with contract requirements.
- D. The Contractor at a price equal to the Owner's contract testing agreement shall pay for owner's tests that do not meet specifications. The Contractor shall pay directly to the testing organization upon invoice to the owner, which has been approved by the Engineer.

PART 3 EXECUTION

3.1 SUBGRADE ESTABLISHMENT

- A. No work shall be performed in this section until subgrade is 100% completed and accepted by the Engineer as being in compliance with Section 31 22 16 Field Subgrade Establishment.
- B. Finish subgrade shall be compacted to a minimum 95% maximum dry density at optimum moisture and +/-2% optimum moisture.
- C. Subgrade shall be established to within the tolerance of +0.00' or -0.10' of the design subgrade elevation.

D. Subgrade shall demonstrate a firm and unyielding condition.

3.2 STRUCTURAL SOIL-BEARING FABRIC INSTALLATION

A. No loose material is allowed on subgrade prior to placement of structural fabric. Loose material is to be removed prior to placement.

B. Fabric to be laid on smooth, compacted, subgrade surface between drainage trenches.

C. The Engineer prior to placement of structural-bearing fabric requires approval of subgrade conditions.

D. Structural fabric must be flat on stabilized subgrade for full width.

E. Dimensions to be a minimum width of 12.5' and minimum continuous length of 150 lf.

F. When the length of the fabric is not continuous, the lateral seam shall have a minimum overlap of 24".

G. Fabric shall not be folded or turned up along the edges.

H. The fabric shall be field cut as necessary to meet specified tolerances of distance from drainage trenches.

I. Structural fabric shall be placed between and into subsurface drainage trenches. Fabric shall be laid flat along trench bottom and smooth along trench wall.

J. Stabilization: Immediately upon laying, the fabric is to be covered with base aggregate. No loaded trucks are to be permitted to move over fabric-covered surfaces until a minimum of 4" of aggregate has been placed, except if specifically approved by the Engineer. The Contractor must execute strict, direct - 100% - control of all vehicle movement on site.

3.3 EQUIPMENT MOVEMENT

A. No trucks or equipment will be allowed to drive over the top of the trenches except track-equipped machinery utilized in spreading base aggregate materials, or where a 12" depth base aggregate temporary roadway has been established. Backfilled trenches are to be staked and "flagged" 3' above grade at 20' minimum intervals for identity.

B. In the event non-track traffic is observed or evidenced to cross trenches, the Contractor shall, at their own expense, expose the drainpipe in the area directed for observation by the Engineer, repair any damage promptly and reinstall backfill per specifications.

3.4 AGGREGATE PLACEMENT

A. Moisture Content: Aggregate to contain 3.5% to 4.0% moisture content to ensure that fines do not migrate and to facilitate proper compaction. Contractor must ensure that aggregate leaving the source plant meets this requirement and is required to apply water to aggregate on site to attain and maintain this minimum moisture content in stockpile and during all placement operations.

B. Prior to aggregate placement, remove any foreign material or contamination from the surface of the structural fabric and drainage trench pea gravel.

C. Surface must be free of standing water and subgrade stabilized with structural fabric in place prior to placement.

D. Materials to be placed in layers not exceeding 8" compacted in depth. Each layer must be spread uniformly with equipment that will not cause perceptible separation in gradation (segregation), preferably a self-propelled paving machine.

E. Should there occur, during any stage of the spreading or stockpiling, a separation of the ma-

terial particles, the Contractor must immediately remove and dispose of segregated material and correct or change handling procedures to prevent any further separation.

3.5 AGGREGATE COMPACTION

- A. Each layer shall be compacted to a minimum density of not less than 95% of maximum dry density as determined by ASTM D698 and measured using a nuclear method.
- B. Use Static Tandem Drum-type roller of not less than five tons weight.
- C. The contractor shall monitor compaction levels to insure the aggregate materials are not over-compacted resulting in infiltration rates that are less than the specified minimum rates.

3.6 AGGREGATE TOLERANCES

- A. The Contractor shall utilize a laser plane system for grade control.
- B. The surface of the base course permeable aggregate in areas to be covered with top course aggregate shall not deviate from designated compacted grade within the range of $-0.50"$ and $+0.00"$.
- C. The surface of the top course permeable aggregate shall not deviate from designated compacted grade within the range of $-0.00"$ and $+0.25"$ and shall not deviate more than $\frac{1}{4}"$ as measured by a 10 foot straight edge.
- D. Upon completion of the fine grading, compaction, and Contractor confirmation of conformance with the tolerances, the Contractor shall notify the Engineer and schedule an inspection for approval. The Contractor shall have a laser plane system available to the Engineer for the inspections. The Contractor shall not be authorized to install synthetic turf over the permeable aggregate until it has been inspected and approved by the Engineer.
- E. Upon completion of elevation verification, the entire permeable aggregate surface shall be inspected for planarity. Planarity inspection shall be completed in conjunction, coordination with the synthetic turf vendor. The installation foreman for the synthetic turf shall be present at the time of the inspection. Inspection shall consist of stretching a stringline taut over the finished permeable aggregate surface at such interval as may be required to confirm surface planarity and acceptance for installation of synthetic turf surface. Any deviation greater than $\frac{1}{4}"$ shall require remediation efforts as may be required to meet subgrade tolerance.

3.7 SYNTHETIC TURF EDGE ANCHOR

- A. Prior to proceeding with Edge Anchor installation, confirm with the Engineer the final elevation for installation relative to adjacent surfaces.
- B. The Edge Anchor may be temporarily set with temporary hardware to establish the proper line and grade. This temporary hardware may remain after final installation.
 - 1. Wedge Anchor
 - a. The Edge Anchor may be temporarily set with power-loads to establish the proper line and grade. This temporary hardware may remain after final installation.
 - b. Once the initial line and grade has been established, pre-drill the edge anchor and establish a void in the adjacent concrete surface that meets the approved anchor supplier's requirements for proper securing of the anchor.
 - c. Minimum requirements for anchor installation:
 - 1.) Depth of Embedment: 3" or as recommended by the anchor supplier, whichever is greater.
 - 2.) Horizontal Spacing: no greater than 36" on center and 12" from end of any length of lumber.
 - 3.) Nut Torque: Per approved manufacturer's recommendation.

- 4.) Do not trim bolt ends. Bolts with trimmed or damaged ends will be rejected and must be removed.
2. Concrete Anchor Nail
 - a. The Edge Anchor may be temporarily set with power-loads placed at the Contractors option to assist in establishing the proper line and grade. This temporary hardware may remain after final installation.
 - b. Once the initial line and grade has been established, install the specified ram-set or power-load driven Concrete Anchoring Nails in manner consistent with the approved manufacturers printed instruction and the specified spacing.
 - c. Minimum requirements for Concrete Anchor Nail installation:
 - 1.) Depth of Embedment: 2" or as recommended by the approved anchor supplier.
 - 2.) Horizontal Spacing: no greater than 21" on center and 6" from end of any length of lumber.
 - 3.) Stagger the spacing of each Anchor up and down within the middle one-half the face of the Recycled Edge Anchor.

END OF SECTION