

TRUMBULL VETERANS & FIRST RESPONDERS CENTER

ONE VETERAN CIRCLE

TRUMBULL, CONNECTICUT 06611

Specifications

Volume 2

May 3, 2025

WA Project #20-800



257 Naugatuck Ave
Milford, CT 06460

TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

210500 FIRE PROTECTION BASIC MATERIALS AND METHODS

210548 SEISMIC CONTROLS FOR FIRE SUPPRESSION
SYSTEMS

211300 FIRE SUPPRESSION SPRINKLERS

DIVISION 22 - PLUMBING

220500 PLUMBING GENERAL CONDITIONS

220517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

220519 METERS AND GAUGES FOR PLUMBING PIPING

220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING

220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND
EQUIPMENT

220553 IDENTIFICATION FOR PLUMBING PIPING AND
EQUIPMENT

220719 PLUMBING PIPING INSULATION

220719.11 UNDER-LAVATORY PIPE AND SUPPLY COVERS -
PLUMBEREX

221005 PLUMBING PIPING

221006 PLUMBING PIPING SPECIALTIES

221250 NATURAL GAS PIPING

221429 SUMP PUMPS

223000 PLUMBING EQUIPMENT

224000 PLUMBING FIXTURES

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

230500 MECHANICAL GENERAL CONDITIONS

230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC

230713 DUCT INSULATION

230923 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

232300 REFRIGERANT PIPING

233100 HVAC DUCTS AND CASINGS

233300 AIR DUCT ACCESSORIES

233423 HVAC POWER VENTILATORS

233700 AIR OUTLETS AND INLETS

237213 AIR-TO-AIR ENERGY RECOVERY UNITS

238101 TERMINAL HEAT TRANSFER UNITS

238128 VARIABLE REFRIGERANT FLOW ZONING SYSTEM

238216 AIR COILS

DIVISION 26 - ELECTRICAL

260502.01 ELECTRICAL GENERAL CONDITIONS

260519 LOW-VOLTAGE POWER CONDUCTORS & CABLES (600
V & LESS)

260526 GROUNDING AND BONDING FOR ELECTRICAL
SYSTEMS

260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

260533.13 CONDUIT FOR ELECTRICAL SYSTEMS

260533.16 BOXES FOR ELECTRICAL SYSTEMS

260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

260919	ENCLOSED CONTACTORS
262100	LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE
262416	PANELBOARDS
262726	WIRING DEVICES
262816.16	ENCLOSED SWITCHES
263600	TRANSFER SWITCHES
265100	INTERIOR LIGHTING
265600	EXTERIOR LIGHTING
DIVISION 28 -	ELECTRONIC SAFETY AND SECURITY
284600	FIRE DETECTION AND ALARM

SECTION 210500 - FIRE PROTECTION BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.

1.3 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 210548 - Seismic Controls for Fire Suppression Systems: Earthquake protection.
- C. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.
- D. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

1.4 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX – Welding and Brazing Qualifications; 2023.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- E. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2018.
- F. ASSE 1015 - Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies; American Society of Sanitary Engineering; 2021.
- G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2022).

- H. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- I. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016.
- J. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014.
- K. ASTM A197/A197M - Standard Specification for Cupola Malleable Iron; 2000 (Reapproved 2019).
- L. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014.
- M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- N. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- O. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- P. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings; 2022.
- Q. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- R. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- S. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- T. AWWA C153 - Ductile-Iron Compact Fittings; 2019.
- U. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2019.
- V. UL (DIR) - Online Certifications Directory Current Edition.
- W. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- X. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for project requirements.
- B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Conform to UL (DIR) requirements.
- C. Valves: Bear UL and FM product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. All permits and fees.
- B. Hoisting, rigging, transportation costs and installation of necessary appurtenances.
- C. The Contractor shall visit the premises and note all pertinent facts and details including conditions under which the work must be carried out. No allowance will be made for failure to have done so.
- D. Holes - Cutting and Patching: Cutting will be by core boring, patch will require both waterproofing and fireproofing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.1 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Comply with NFPA 13.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.2 BURIED PIPING

- A. Ductile Iron Pipe: AWWA C151/A21.51, 125 pound WSP, Class 52, exterior bituminous coating, AWWA C104 cement-mortar lined.
 - 1. Fittings: AWWA C110 or C153 mechanical joint, Class 350, exterior bituminous coating, AWWA C104 cement mortar lined.
 - 2. Joints: AWWA C111, SRB rubber gasket.
 - 3. Mechanical joint: Shaped composition sealing gasket, T-bolts, and nuts, low alloy corrosion resistant high strength steel.

2.3 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A 795 Schedule 10 or ASTM A795 Schedule 40, black or galvanized. Hot-dip galvanizing shall conform to ASTM A123; average weight of coating shall be not less than 1.8 oz. per sq.ft. of surface (inside and outside).
 - 1. Standard weight Schedule 40 with grooved coupling in sizes 1-1/2" and 2". Standard square cut grooves to coupling manufacturer's specifications.
 - 2. Standard weight Schedule 40 with threaded coupling and fittings in sizes 2" and smaller.
 - 3. Light wall Schedule 10 with grooved couplings in sizes 2-1/2" and larger. Rolled grooves; no cut grooves or threading will be allowed on Schedule 10.
- B. Fittings
 - 1. Steel Fittings: ASME B16.9 wrought steel, buttwelded.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings. Zinc coated with galvanized pipe, ASTM A153 hot-dip galvanized.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings, ASTM A47 and ASTM A197. Zinc coated with galvanized pipe, ASTM A153 hot-dip

galvanized.

C. Mechanical Grooved Couplings and Fittings: (Based on Victaulic)

1. Fittings: Ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47. Zinc coated with galvanized pipe, ASTM A153 hot-dip galvanized. Fitting shall be from same manufacturer as couplings.
2. Couplings: Housing clamps to engage grooves and lock "C" shaped elastomeric sealing gasket with bolts and nuts. Victaulic Style 009 and 75 Couplings. Housing of ASTM A536 ductile iron. ASTM A153 hot-dip galvanized for exterior applications. Gasket Grade "E" EPDM (Type A) Flushseal. Heat-treated plated carbon steel trackhead bolts per ASTM A449 and ASTM A183.
3. Mechanical Tee: Mechanical coupling for outlet or branch mating housing with elastomeric gasket over hole cut in pipe. Victaulic Styles 920 and 920N bolted branch outlets. Housing of ASTM A536 ductile iron. ASTM A153 hot-dip galvanized for exterior applications. Gasket Grade "E" EPDM. Heat-treated plated carbon steel trackhead bolts per ASTM A449 and ASTM A183.

2.4 COLD GALVANIZING COMPOUND

- A. Cold galvanizing of steel piping, fittings, hangers and supports as an equivalent to hot-dip galvanizing. For use in repair of hot-dip galvanizing in shop fabrication and field installation.
1. Metallic zinc content, 95 percent by weight in dry film.
 2. Solids content, 52 percent by volume.
 3. Application rate, 1.5 mils dry film thickness per coat.
 4. Number of coats required, 2.
 5. Flat grey finish.
- B. Product: ZRC Cold Galvanizing Compound, premixed liquid organic zinc compound, by ZRC Worldwide, or approved equal.

2.5 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 3/8 to 3 inch: Malleable iron, split ring extension hanger. Electro-zinc plated per ASTM B633.
- B. Hangers for Pipe Sizes 1 inch and Over: Carbon steel, adjustable ring, with knurled swivel. NFPA threaded rod sizes. Exterior installation shall be with stainless steel all thread rod.

- C. Hanger attachment to structural steel beam: Universal or wide mouth malleable iron C-type beam clamp with locknut, U.L. Listed. Electro-zinc plated per ASTM B633. Secure with retaining strap hammered tight to beam flange.
- D. Hanger attachment to concrete: Set-in expansion anchors to rated capacity or self drilling anchors where weight of piping does not exceed half of rated capacity.
- E. Hanger attachment to wood structure: Carbon steel or malleable iron side beam bracket with tapped rod hole or carbon steel side beam bracket with punched hole and double rod nuts. Attach with pair of 1-1/4" screws for pipe 2" and under and lag screw or through bolt and washers for pipe over 2". Exterior installation shall be with electro-zinc plated malleable iron bracket and stainless steel all thread rod.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- G. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- H. Vertical Support: Steel riser clamp.
- I. Floor Support: Cast iron adjustable pipe saddle with U-bolt, threaded pipe adjuster, cast iron floor flange, and steel pipe support.

2.6 GATE VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body with union bonnet, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- B. Over 4 inches:
 - 1. Class 125 flanged cast iron body, rising stem with bolted bonnet, resilient wedge, OS&Y gate valve, 200 PSI non-shock water pressure. UL listed and FM approved.

2.7 BALL VALVES

- A. Up to and including 2 inches:
 - 1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

2.8 BUTTERFLY VALVES

A. Bronze Body:

1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC. UL listed and FM approved

B. Ductile Iron Body

1. Epoxy coated ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive, 175 PSI non-shock water pressure. Integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC. UL listed and FM approved

2.9 CHECK VALVES

A. Up to and including 2 inch:

1. Bronze body and swing disc, rubber seat, threaded ends.

B. 4 inch and Over:

1. Iron body, bronze mounted, swing check with rubber disc, renewable disc and seat, flanged maintenance port, grooved or flanged ends with automatic ball check. 175 PSI non-shock water pressure. UL listed and FM approved.

2.10 DRAIN VALVES

A. Ball Valve:

1. Brass with cap and chain, 3/4 inch hose thread.

2.11 DOUBLE CHECK VALVE ASSEMBLIES

A. Double Check Valve Assemblies:

1. ASSE 1015; Ductile or cast iron body with corrosion resistant internal parts and stainless steel springs; two independently operating, spring loaded check valves. All bodies epoxy coated, check valves with removable bronze seat, tight sealing rubber faced disc, test cocks bronze body ball valves, 175 PSI working pressure. UL listed and FM approved.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Fire protection piping shall be seismically restrained per the current Building Code.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipes passing through partitions, walls, and floors.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3.3 HANGERS AND SUPPORTS

- A. Pipe Hangers and Supports:
 - 1. Place hangers within 12 inches of each horizontal elbow. Any sprinkler pipe over 1'-6" in length requires a hanger and the maximum overhang beyond the last hanger shall not exceed 1'-6". Hangers are to be installed on both sides of grooved pipe couplings.
 - 2. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe. End of line hangers for pendent sprinklers shall prevent upward

movement of pipe.

3. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
4. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

3.4 PIPING SYSTEM

- A. The piping system shall be arranged so that the entire system can be flushed and drained through accessible low points. Slope piping towards main drain or provide auxiliary drains for water in trapped sections of pipe.
- B. Pipe and fittings for drain lines shall be galvanized.
- C. Do not penetrate building structural members unless indicated.
- D. Provide sleeves when penetrating floors, walls, and foundations. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required. Firestop floor penetrations in un-rated floors to a minimum of 1 hour UL fire rating.
- E. Escutcheons:
 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
 3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- F. Dry Pipe Sprinkler Systems shall be fabricated from galvanized steel pipe and fittings. No welded fittings or connections of any type shall be part of the piping installation and fabrication for the exterior piping.
- G. Grooved fittings and couplings shall be installed in accordance with the manufacturer's recommendations. Piping shall be cut and prepared per the coupling manufacturer's standards.
- H. Threaded joints shall be made with teflon liquid joints compound applied to male threads only.
- I. Chrome-plated escutcheon shall be used on all exposed piping with penetrates either walls or ceilings.

3.5 GALVANIZING REPAIR COMPOUND

- A. Preparation: Surfaces to be coated shall be clean; i.e. devoid of grease, oil, mill scale, oxidation, loosely adherent rust, paint, etc. Coating shall be applied directly to metal surface to be galvanically active.
- B. Application: The coating shall be applied at sufficient wet film thickness to achieve a minimum dry film build of 2.5 - 3.5 mils, using manufacturer's recoat time directions. The coating shall be well stirred before use so that it is completely homogeneous during application. Apply with brush, thin only with products as recommended by the manufacturer.

3.6 VALVES

- A. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- B. Provide drain valves at main shut-off valves, low points of piping and apparatus. All drain piping shall be galvanized.
- C. Tag and label all valves and riser in accordance with Section 220553
- D. Backflow Preventer: Install per manufacturer's instructions and requirements of the Public Health Code.
 - 1. Installation shall provide adequate space for testing, repair and maintenance.
 - 2. Ensure valve assembly trim is provided in right hand or left hand configuration as appropriate for access in installed location.
 - 3. Thoroughly flush piping prior to installing backflow prevention assembly.
 - 4. Perform certification test of backflow preventer in accordance with the New England Water Works Association guidelines for field test procedure; and furnish report.

END OF SECTION 210500

SECTION 210548 - SEISMIC CONTROLS FOR FIRE SUPPRESSION 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 SECTION INCLUDES

- A. Seismic restraint/expansion.

1.3 REFERENCES

- A. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2019.

1.4 DESCRIPTION

- A. Work of this Section includes furnishing and installing seismic restraint/expansion for Fire Suppression equipment, piping and raceway systems furnished under this Division.
- B. Fire Suppression equipment, piping and raceway systems shall be seismically restrained as required by Section 1613 of the International Building Code adopted by the 2022 Connecticut State Building .

1.5 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for project requirements.
- B. Product Data: Provide literature for each type device proposed with load rating for associated anchorage and fasteners.
- C. Shop Drawings: Show location of seismic restraints on Fire Suppression Shop Drawing.
 - 1. Calculate total lateral and longitudinal forces, in pounds for each pipe or conduit segment and piece of equipment. Submit Seismic Bracing Calculations on form similar to Figure A.18.5(a) found in NFPA 13 Appendix A. Take the coefficient for the weight of pipe as 0.375.
 - 2. For seismic restraints: published data or certificated drawings showing construction details, capacities and calculated force acting in all directions at each point of attachment, or California OSHPD pre-approved "R" numbers, certifying G force capabilities.

- D. Seismic calculations shall be submitted with the seal of a professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated.
- E. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

PART 2 PRODUCTS

2.1 SEISMIC RESTRAINTS

- A. Fire Suppression equipment and piping requiring seismic bracing shall be supported by structure designed to withstand the lateral and longitudinal forces as determined in the current applicable Building Code.
- B. Seismic bracing for Fire Suppression equipment and piping shall be a rigid member seismic restraint system utilizing components from the Tolco seismic bracing system manufactured by Cooper B-Line. Or equal products from Anvil International Inc., PHD Manufacturing Inc. or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish all labor, materials, tools, appliances, and equipment and perform all operations necessary for the complete execution of the installation of vibration isolation devices and seismic restraints specified in this section.
- B. Installation of all vibration isolation material specified herein shall be accomplished following the manufacturer's written instructions.
- C. The installation of seismic control measures shall conform to the referenced edition of NFPA 13.

3.2 PIPING SYSTEMS

- A. Horizontal Piping: Where required piping shall incorporate seismic restraint cables at all changes of direction. Consult to structural plans for suitability of anchorage and reference table on drawings for spacing restraints. The interval of lateral restraints shall never exceed 40 feet.
- B. Vertical Piping: Riser clamps shall be anchored at each floor to provide seismic restraint.
- C. Provide longitudinal restraints at interval of double the lateral spacing but never to exceed 80 feet.

- D. Provide flexible couplings in all pipe runs up to masonry walls and all risers running floor to floor. Install adjacent to both sides of pipe penetrations through floors and walls per NFPA 13.

3.3 INSTALLATION

- A. Hangers shall be suspended from and restrained by substantial structural members, not the slab diaphragm, unless specifically approved by the Architect.
- B. Seismic restraints shall be installed after equipment is in operating position to assure design clearances are maintained.

3.4 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report.

END OF SECTION 210548

SECTION 211300 - FIRE SUPPRESSION SPRINKLERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Wet-pipe sprinkler systems.
- B. Dry-pipe sprinkler systems.
- C. System design, installation, and certification.
- D. Fire department connections.

1.3 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 210500 - Fire Protection Basic Materials and Methods: Pipe, fittings, and valves.
- C. Section 210548 - Seismic Controls for Fire Suppression Systems.
- D. Section 220553 - Identification for Plumbing Piping and Equipment.
- E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.
- F. Section 284600 - Fire Detection and Alarm.

1.4 SYSTEM DESCRIPTION

- A. Systems to provide coverage for the new community center building.
- B. Provide hydraulically designed automatic wet pipe and dry pipe sprinkler systems. Water supply from new 6" water service connected to existing 16" water main at the end of Veteran's Circle with feed from the municipal water main in Whitney Avenue.
- C. Furnish all necessary labor, materials, tool, equipment, appurtenances, instruments, etc. necessary to fully complete the Fire Protection System in accordance with the plans and specifications and both local and state fire codes and NFPA 13.

1.5 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide current edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2019.
- C. UL (DIR) - Online Certifications Directory current edition.

1.6 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for project requirements.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
 - 3. Submit shop drawings and hydraulic calculations to authority having jurisdiction, Rating Bureau and RZ Design Associates, Inc. for approval.
 - 4. Provide copy of comments received from AHJ to Project Engineer.
- D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, Test Certificates, replacement part numbers and availability, and location and numbers of service depot.

1.7 QUALITY ASSURANCE

- A. Comply with UL (DIR) requirements.
- B. Design by a NICET Level IV Certified Sprinkler Technician or under direct supervision of a Professional Fire Protection Engineer experienced in design of this type of work and licensed in Connecticut.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience and approved by manufacturer.
- E. Equipment and Components: Provide products that bear UL label or marking.

1.8 CONTRACTOR'S RESPONSIBILITIES

- A. Drawings are diagrammatic; do not rely on scaling of drawings. Make such deviations and offsets as necessary to meet the space requirements.
- B. The contractor shall be responsible for water damage to the property of the owner, the work of other trades, and existing building systems during all phases of the work.
- C. Coordination Drawings: The Fire Protection Contactor shall incorporate the shop drawing sprinkler design into the master coordination drawings and work with the other trade contractors to resolve conflicts.

1.9 EXTRA MATERIALS

- A. Provide extra sprinklers of type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
- B. Provide suitable wrenches for each sprinkler type.
- C. Provide red enamel finished steel sheet metal storage cabinet in location designated.

PART 2 PRODUCTS

2.1 SPRINKLERS

- A. Suspended Ceiling Type: Recessed pendent type with matching push on escutcheon plate.
 - 1. Finish: Chrome plated.
 - 2. Escutcheon Plate Finish: Chrome plated.
 - 3. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.
- B. Suspended Ceiling Type: Concealed pendent with white cover plate.
 - 1. Fusible Link: Glass bulb type or fusible link type, quick response, temperature rated for specific area hazard.
- C. Exposed Area Type: Standard upright type.
 - 1. Finish: Brass.

2. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.
- D. Sidewall Type: Standard horizontal sidewall type with matching push on escutcheon plate.
 1. Escutcheon Plate Finish: Chrome plated.
 2. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.
- E. Dry Sprinklers: Recessed dry sidewall type with matching push on escutcheon plate.
 1. Finish: Chrome plated.
 2. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.
- F. Conventional Type: Old Style upright for protection of combustible structure above.
 1. Finish: Brass.
 2. Fusible Link: Glass bulb type, quick response, temperature rated for specific area hazard.

2.2 FLEXIBLE SPRINKLER DROPS

- A. Description: Flexible Sprinkler Hose Fittings for use in commercial suspended ceilings.
 1. Product Performance Criteria: UL Listed pursuant to UL 2443 Standard for Flexible Sprinkler Hose with Fittings for Fire Protection Service. FM Approved pursuant to FM Class Number 1637 Approval Standard for Flexible Sprinkler Hose with Threaded End Fittings.
 2. Materials and Fabrication: Flexible Sprinkler Hose Assemblies and End Fittings.
 - a. Hose: AISI 304 Stainless Steel corrugated flexible hose with AISI 304 Stainless Steel braided jacket. Welded stainless steel collars and brass slip nuts with EPDM seals. Hose bore 28 mm internal corrugated hose diameter, minimum rated pressure 175 psi, and maximum length 1800 mm (6 Ft).
 - b. Inlet nipple and outlet reducer of Zinc-Plated Carbon Steel. 1" NPT inlet and straight outlet with 1/2" or 3/4 NPT sprinkler reducer with clamp bar flats.

- c. Ceiling Brackets and Support Bar: Zinc-Plated Carbon Steel assemblies intended for installation into commercial suspended ceilings having medium to heavy support tee bars meeting ATSM C-635 and installed in accordance with ASTM C-636. Assemblies shall be adjustable with set-screws and clamps that anchor the sprinkler securely to the ceiling grid and are suitable for both pendent and concealed type heads.

2.3 SPRINKLER SPECIALTIES

- A. Riser Check Valve: Swing check type valve with drain and gauge ports. Ductile iron body featuring covered access port for maintenance of internal components without removing valve from installed position; spring loaded, stainless steel clapper with EPDM rubber face and bronze seat ring. Trim to include angle drain valve, supply and system pressure gauges. UL listed and FM approved.
- B. Dry Pipe Valve: Latching differential pressure type check valve, rubber faced clapper to automatically actuate electric alarm bell, with air maintenance device; with test and drain valve. Furnish accelerator as necessary to satisfy water delivery response time. UL listed and FM approved.
- C. Inspector's Test Connection: Section drain valve with integral test port, single bronze body ball valve with minimum 1" NPT inlet and outlet, chromium plated bronze ball, glass impregnated teflon valve seat, two fused tempered sight glasses and 1/2" test orifice. UL listed and FM approved. Provide AGF Manufacturing Inc. Model 3011SG or approved equal.
- D. Air Venting Valves: Equip wet-pipe sprinkler systems with automatic float type air vent. Provide AGF Model M7900AAV; forged brass body assembly with integrated ball valve, stainless steel strainer and purge valve with hose fitting. Install at high point in each sprinkler zone.

2.4 ACCESSORIES

- A. Pressure Switch: Service pressure of 175 PSI, operating a pressure of 4 to 8 PSI, two SPDT contacts rated at 10 amp at 125 volt AC and 2.5 amp at 24 volt DC. Provide electrically operated red enameled bell with where noted. As manufactured by Potter, Model PS10-2 or equal by System Sensor or Notifier.
- B. Water Flow Switch: Vane type switch, aluminum pipe saddle mount, polyethylene paddle, adjustable retard and tamper-proof housing, with two SPDT contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC. As manufactured by Potter Electric, Model VSR-F or equal by System Sensor or Notifier.

- C. Alarm Bell: Vibrating bell, 8 inch red powder coat finish, 120 volts AC. Bell shall conform to UL 464; furnish with weatherproof back box. As manufactured by Potter Electric, Model PB1208 or equal by System Sensor or Notifier. Minimum 75 dB at 10 feet.
- D. Supervisory Switches: For monitoring open position of OS&Y gate valve, integral mounting bracket with adjustable clamp bar. Tamper-proof switch housing with two SPDT contacts rated at 15 amp at 125 volt AC and 2.5 amp at 30 volt DC. As manufactured by Potter, Model OSYSU-2 or equal by System Sensor or Notifier.
- E. Low Pressure Switch: Service pressure of 250 PSI, operating a pressure of 30 PSI, two SPDT contacts rated at 10 amp at 125 volt AC and 2.5 amp at 24 volt DC. As manufactured by Potter, Model PS40-1 or equal by System Sensor or Notifier.

2.5 AIR COMPRESSOR

- A. Compressor: Two cylinder, tank-less, oil-less, direct drive unit. Thermally protected motor, motor starter, safety relief valve, check valve and pressure switch. Include air maintenance device incorporating pressure regulator.
- B. Electrical Characteristics:
 - 1. 3/4 hp.
 - 2. 125 volts, single phase, 60 Hz.

2.6 FIRE DEPARTMENT CONNECTIONS

- A. Type: Two way projecting wall mounted inlet.
- B. Cast brass body with individual drop clapper valves. Chrome plated finish, 2-1/2" Pin lug swivels, pin lug plugs and chains. Threads to local fire department specification.
- C. Escutcheon: Round cast brass, chrome plated finish, lettering "AUTO. SPKR."
- D. Product: Croker Fig. 6430-RC or equal by Elkhart Brass or Potter Roemer.

2.7 HOSE VALVE TEST HEADER

- A. Type: Flush backflow preventer test header.
- B. Cast brass body with angle inlet and two outlets, chrome plated non-rising stem hose gate valves with loose bonnets, 3" female NPT inlet and 2-1/2" male hose thread outlet, and caps and chains. Threads to local fire department specifications.

- C. Escutcheon: Rectangular chrome plated, lettering "BACKFLOW PREVENTER TEST CONNECTION".
 - 1. Product: Potter Roemer Fig. 5862-3-C with Fig. 4335 valve or equal by Elkhart Brass or Croker.

PART 3 EXECUTION

3.1 GENERAL

- A. The complete system shall be installed in accordance with Rules and Regulations pertaining to Light Hazard (not to exceed 168 sq. ft. per head - system hydraulically calculated; not sized per pipe schedule) and Ordinary Hazard Group 1 occupancies and comply with the full requirements of the regulatory agencies.
- B. The Fire Protection Contractor shall have hydrant flow tests conducted on the fire hydrants hydraulically closest to the new water service entrance. Conduct test and record test data in accordance with NFPA 291.
 - 1. Obtain flow test data, attested to by Clerk of the Works, which is adequate to base the design on. Data will be judged adequate if the actual flow values measured during flow test equal or exceed total demand. Flow values extrapolated from measured flow values may not be used as a basis for design.
- C. The Fire Protection Contractor shall have prepared by a NICET Level IV Certified Sprinkler Technician or under a P.E. work installation drawings (Shop Drawings) and shall submit them to the engineer and Rating Bureau for approval.
- D. Shop Drawings shall include all hydraulic calculations prepared on forms similar to those in NFPA 13 Appendix A.
- E. Design Criteria:

Light Hazard - 0.10 GPM/Sf density over the most remote 1500 sq.ft. for interior and exterior assembly spaces, offices and toilets. Protection area limitation 168 sq.ft. with standard coverage sprinklers.

Ordinary Hazard Group 1 - 0.15 GPM/SF density over the most remote 1500 sq.ft. for Basement and Kitchen. Protection area limitation 130 sq.ft.

Calculations shall allow a 10 percent safety factor for future deterioration of the water supply.
- F. Before commencing work, the Fire Protection Contractor shall coordinate with other trades, so that no possible interferences will occur. If due to inadequate

coordination, extra work is entailed, the Fire Protection Contractor shall be held fully responsible.

3.2 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Locate outside alarm bell on exterior of building wall above fire department .
- D. Place pipe runs to minimize obstruction to other work. Special care must be taken to insure that piping above hung ceilings is run to maintain maximum headroom and clearance for access to equipment of other trades and to avoid conflict with electrical conduits, light fixtures, other piping, ductwork etc.
- E. Pipe shall be run concealed throughout finished spaces. Place above finished ceilings or in chases, shafts, wall cavities or soffits. Exposed piping shall be run with care for aesthetics, minimizing fittings and offsets and creating symmetry in the in the installation.
- F. In gridded sprinkler systems, the water velocity shall not exceed 20 ft./sec. in branch lines 2" and smaller.
- G. Pipe size for drops to sprinkler heads located below suspended ceilings shall be 1 inch minimum.

3.3 SPRINKLER HEADS

- A. Sprinkler heads of the proper configuration and numbers are to be installed as required in accordance with regulations pertaining to Light and Ordinary Hazard Occupancies and meet the full requirements of the NFPA, Local Fire Department, State Fire Marshal, Fire Insurance Company, Rating Bureau and other agencies having jurisdiction.
- B. Center sprinklers in ceiling tiles except where indicated otherwise. Provide and adjust arm over assemblies as necessary.
- C. Where flexible sprinkler drop are used the minimum bend radius shall be 7 inches. Use FM equivalent length in hydraulic calculations. The ceiling support brackets shall be attached to the main tee bar runner in the grid, not the cross support rails. Follow all manufacturer's instructions.
- D. Apply masking tape or paper cover to ensure sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- E. Install heads with Teflon liquid joint compound applied to male threads only.

- F. Install guards on sprinklers in locations subject to mechanical damage.
- G. Mount sprinkler head cabinet in the location directed by the Owner Representative. Stock with spare sprinkler heads of each type and or temperature rating and a sprinkler head wrench per NFPA 13.

3.4 FIRE DEPARTMENT CONNECTION

- A. The fire department connection shall be made on the system side of the backflow preventer in the supply piping. There shall not be a shut-off valve in the fire department line.
- B. The pipeline between the check valve and the outside hose coupling shall be equipped with an approved automatic drip.
- C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- D. Installation shall conform with the requirements of the local Fire Department, and the Rating Bureau in accordance with NFPA.

3.5 INSPECTOR'S TEST CONNECTIONS

- A. Install at end of most remote branch line, valve shall not be over 7'-0" above floor. Terminate connection outside building with 1 inch 45 degree elbow. Flow shall be equivalent to one sprinkler head.
- B. Inspector's test connections shall be mounted so as to be easily reached for test purposes without need for the use of a ladder.

3.6 TESTING

- A. Hydrostatically test entire system. Test system at no less than 200 psi for two (2) hours after completion, in accordance with NFPA 13.
- B. Flush entire piping system of foreign matter. Furnish to the insurance carrier, Contractor's Material and Test Certificate. Fill in and sign form as outlined in NFPA 13.
- C. During and after completion, the entire installation shall be subject to inspection and testing by the insurance carrier.
- D. Notify authority having jurisdiction of testing.

3.7 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION 211300

SECTION 220500 - PLUMBING GENERAL CONDITIONS

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 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 01 91 13 - General Commissioning Requirements.
- B. Complete installation, startup checks and functional tests according to Section 01 91 13 - General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new ones and repeat the start up procedure.
- D. Verify that equipment is installed and commissioned as per requirements of Section 01 91 13 and manufacturers written instructions/requirements.

1.3 DESCRIPTION

- A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.
- B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein.
- C. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division.
- D. The following information contains specifications of Work in connection with, and in addition to, this Division:
 - 1. All drawings associated with the project.
 - 2. All specifications associated with the project.

- E. Division of work responsibilities shall be as defined and directed by the Bidding Agent and/or the Bidding General Contractor.

1.4 INTENT

- A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.
- B. Furnish, deliver and install any apparatus, appliance, material or Work not shown on Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the Work complete and perfect in all respects and ready for operation, even if not particularly specified, under their respective Section without additional expense to the Owner.
- C. Include in the work minor details not usually shown or specified but necessary for proper installation and operation, as though they were hereinafter shown or specified.
- D. Provide Engineer written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of Work omitted. In the absence of such written notice, it is mutually agreed that Work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.
- E. The Work indicated is diagrammatic. The Architect and/or Engineer may require as part of this Contract, the relocation of devices to reasonable distances from the general locations shown.
- F. Verbal clarifications of the Drawings or Specifications during the bid period are not to be relied upon. Refer any questions or clarifications to the Engineer at least five Working days prior to bidding to allow for issuance of an addendum. After the five-day deadline, Bidder must make a decision and qualify the Bid, if the Bidder feels it necessary.

1.5 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. (Do not scale the Drawings.) Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect.
- B. Closely follow Drawings in layout of Work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.

- C. Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.
- D. Where variances occur between the Drawings and Specifications or within either of the Documents, include the item or arrangement of better quality, greater quantity or higher cost in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

1.6 SURVEYS AND MEASUREMENTS

- A. Before submitting a Bid, the Contractor shall visit the site and shall become thoroughly familiar with all conditions under which the work will be installed. Contractor will be held responsible for any assumptions, omissions or errors made as a result of failure to become familiar with the site and the Contract Documents.
- B. Base all measurements, both horizontal and vertical, from established bench marks. All Work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the Work.
- C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or the intent of the Drawings and Specifications, notify the Engineer do not proceed with that Work until instructions have been received from the Engineer.

1.7 CODES AND STANDARDS

- A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.
- B. The current adopted editions of the following State or local Codes apply:
 - 1. Connecticut State Building Code with Amendments to the following:
 - a. International Building Code
 - b. International Mechanical Code
 - c. International Plumbing Code
 - d. Connecticut Gas Equipment and Piping Code
 - e. National Electrical Code (NFPA 70)
 - f. International Energy Conservation Code

g. ICC/ANSI A117.1-2017 Accessible and Usable Buildings and
Facilities

- C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.8 PERMITS AND FEES

- A. Give all necessary notices, obtain all permits; pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Work. File all necessary Drawings, prepare all Documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspections for Work and deliver a copy to the Engineer before request for acceptance and final payment for the Work.

1.9 SEISMIC RESTRAINT

- A. General: Verify current seismic requirements based on project location and with Code requirements. If This project is in a seismic zone per State and/or Local Codes and Ordinances and all materials and equipment shall be installed, supported, and seismically restrained accordingly.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated.
Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those required for this Project in material, design, and extent.
- C. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:
 - 1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, design of seismic supports and selection of seismic restraints for all equipment and materials.
 - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment.

Include auxiliary motor slides and rails, and base weights.

3. Seismic Restraint Details: Detail fabrication and attachment of restraints, supports and snubbers.
 4. Seismic Separation Assemblies: Refer to the Architectural and/or Structural drawings for locations of seismic joints.
- D. Installation: Installation shall be carried out in strict accordance with the Seismic Engineer's submittal, current Code, accepted standards and the equipment and material manufacturers' recommendations.

1.10 COORDINATION

- A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.
- B. Mechanical contractors' shall initiate coordination drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the Owner. The Contractors' shall prepare coordination drawings at a scale no less than 1/4"=1'-0", showing the work of all trades, including but not limited to, the following: proposed ductwork installation in detail, including ceiling heights, approved structural steel shop drawings, duct heights, access doors, light fixtures, registers and diffusers, sprinkler piping, electrical distribution conduits, wires, panels and any other electrical work which may conflict with the sheet metal ducts or piping, waste and vent piping, water piping, storm piping, and rain leaders. Provide elevation details showing connections and equipment layout and configuration based on approved submittals. Each shall use a different color code. A coordination meeting of all Contractors involved is then to be held and all possible conflicts are to be resolved. All trades shall sign acceptance of the drawings and then shall submit two (2) prints of each drawing to the Engineer for record.
- C. Contractors are required to examine all of the Project Drawings and mutually arrange Work so as to avoid interference. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer regarding the arrangement of Work, which cannot be agreed upon by the Contractors, will make final decisions. Service of equipment will take precedence.

- D. Where the Work of the Contractor will be installed in close proximity to or will interfere with Work of other trades, assist in working out space conditions to make a satisfactory adjustment.
- E. If Work is installed before coordinating with other Divisions or so as to cause interference with Work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.
- F. Initial contact and coordination has been conducted with utility entities for the purpose of the preparation of Bid Documents. The Contractor shall coordinate all final specific utility requirements.

1.11 ACCEPTANCES

- A. The equipment, materials, Workmanship, design and arrangement of all Work installed are subject to the review of the Engineer.
- B. Within 30 days after the awarding of a Contract, submit to the Engineer for review a list of manufacturers of equipment proposed for the Work. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.
- C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, notify the Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.
- D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog or model number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.
- E. If material or equipment is installed before shop drawing review, liability for its removal and replacement is assumed by the Contractor, at no extra charge to the Owner, if, in the opinion of the Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.
- F. Failure on the part of the Engineer to reject shop drawings or to reject Work in progress shall not be interpreted as acceptance of Work not in conformance with the Drawings and/or Specifications. Correct Work not in conformance with the Drawings and/or Specifications whenever non-conformance is discovered.

1.12 EQUIPMENT DEVIATIONS

- A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing within 60 days from the Award of Contract. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified, and the amount of credit involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts.
1. The Base Product Specification shall be based on using the materials and equipment as specified and scheduled with no exceptions. Equipment Manufacturers Scheduled on Drawings are considered Base Product Specification and any other acceptable manufacturers listed in the specifications is considered an equivalent manufacturer to the Base Product Specification. Unlisted manufacturers are considered a substitution and equipment deviation and subject to the requirements for equipment substitution and deviation. When any alternate manufacturer does not qualify acceptable, as determined by the Engineer, provide the Base Bid manufacturer at no additional cost to Owner.
 2. Where an equivalent manufacturer is listed in the specifications, it may or may not indicate that there is an equal product available. Any products must meet all criteria of the Base Product Specification as determined by the Engineer.
- B. Substitutions and Equipment Deviations will not be considered if they have a direct bearing on the changing or revising of Contract Documents or if it involves other Contractor's scope of work or thier equipment. Coordination with all trades is required and must be acceptable to all other involved Contractors.
- C. Substitutions may be considered for one of the following:
1. Substitution for Cause: Changes proposed by the Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of warranty terms.
 2. Substitutions for Convenience: Changes proposed by the Contractor or Owner that are not required in order to meet other Project requirements, but may offer advantage to either the Owner or Contractor.
- D. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. In the event that only one (1) manufacturer of a product is specified and it is found that the

manufacturer has discontinued the product, the Contractor shall use an acceptable equivalent product that meets the requirements of an equivalent product, as noted below, and has all the features of the originally specified product. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

- E. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.
- F. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words "or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with this Specification.
- G. Equipment, material or devices submitted for review as an "accepted equivalent" shall meet the following requirements:
 - 1. The equivalent shall have the same construction features such as, but not limited to:
 - 2. Material thickness, gauge, weight, density, etc.
 - 3. Welded, riveted, bolted, etc., construction
 - 4. Finish, undercoatings, corrosion protection
 - 5. The equivalent shall perform with the same or better operating efficiency.
 - 6. The equivalent shall have equal or greater reserve capacity.
 - 7. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
 - 8. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.
- H. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

- I. Where such accepted deviation or substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.
- J. The Engineer shall determine if an "accepted equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.13 SHOP DRAWINGS

- A. Refer to individual specification sections for additional submittal information.
- B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed.
- C. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (9) copies for review.
- D. Provide shop drawings for all devices specified under equipment specifications for all systems, materials, equipment and/or devices. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal. Partial submissions shall be rejected.
- E. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves, based solely on design performance, will not be accepted.
- F. All specific options and/or alternatives shall be clearly indicated. Failure to do so shall be grounds for rejection.
- G. Submittals shall be marked with the trade involved, i.e., HVAC, plumbing, fire protection, etc. and the specific associated specification section.

- H. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.
- I. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. Contractor must allow for a one week review at the Engineer's office plus normal delivery time to the G.C., Architect, Engineer, and return to the Architect, and G.C. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer. The Contractor shall incur all costs associated with delay of construction due to equipment and/or materials arriving late due to late or improper shop drawing submittal.
- J. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.
- K. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not indicate that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.
- L. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.
- M. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.
- N. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.
- O. Contractor shall make any corrections required by Engineer and shall resubmit required number of corrected copies of shop drawings or new samples until accepted. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than corrections requested by Engineer on previous submissions. Engineer shall review no more than one resubmittal of any shop drawing or sample at Owner's expense. The fees for review of additional resubmittals shall be paid by the Contractor at the Engineer's standard rates.

1.14 CHANGES IN WORK

- A. A Change Order is a written order to the Contractor signed by the Owner and the Architect, issued after Contracts have been awarded, authorizing a change in the work or an adjustment in the Contract sum or the Contract time. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract sum or the Contract time.
- B. All changes in the work shall follow the recommendations of the AIA "General Conditions of the Contract for Construction", Article 12.

1.15 MANUFACTURER'S IDENTIFICATION

- A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial and model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. Nameplate data shall not be obstructed. The nameplate of a Contractor or distributor will not be acceptable.
- B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by UL, or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

1.16 RECORD DRAWINGS

- A. Maintain at the job site a record set of Project Drawings on which any changes in location or routing of all equipment, materials and access panels shall be recorded.
- B. At the end of construction, the Contractor shall provide the Owner with a complete set of As-Built Drawings, including all updated coordination drawings, ductwork and piping plans. As-Builts shall be drawn on the latest version of Autocad or compatible software, approved in writing, prior to submittal. The Owner shall be provided with a "CD Rom" disk and one set of reproducible mylar sepias.

1.17 MATERIALS AND WORKMANSHIP

- A. All materials and apparatus required for the work, except as otherwise specifically indicated, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and be so selected and arranged as to fit properly into the building spaces. Where no specific type or quality of material is given, a first-class standard article as accepted by industry standards shall be furnished.

- B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.
- C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.
- D. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.18 PROTECTION OF MATERIALS AND EQUIPMENT

- A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.
- C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.19 BASES AND SUPPORTS

- A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, framing, bases and piers required for all equipment furnished under this Division.
- B. Unless otherwise indicated in individual trade Sections, pumps, fans, air handlers, boilers, chillers, tanks, compressors and other rotating machinery shall be mounted on a minimum of six (6") inch high concrete pads which shall be furnished and installed per Division 3. All pads shall be extended six (6") inches beyond machine base in all directions with top edge chamfered. Shop drawings of all foundations and pads shall be submitted to the Engineer for review before they are constructed. The Mechanical Contractor shall field coordinate all required dimensional and necessary loading information.
- C. Construction of foundations, supports, pads, bases and piers where mounted on the floor shall be of the same finish quality as the adjacent and surrounding flooring material.
- D. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.
- E. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic Codes.

1.20 SLEEVES, INSERTS AND ANCHOR BOLTS

- A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.
- B. It is the responsibility of the Contractor to furnish cast-in-place steel sleeves, inserts and anchors in sufficient time to be installed during initial concrete pours. Where job schedules make this impossible, coordinate and obtain acceptance from the Structural Engineer for alternate installation methods.
- C. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an inside diameter one (1") inch larger than the outside diameter of the pipe, conduit or insulation enclosing the pipe.

- D. Piping insulation shall run continuous through sleeve.
- E. Penetrations through fire-rated walls, ceilings and all floors (except slab on grade) in which piping or ducts pass shall be filled solidly with acceptable fire-stopping material. Sleeves shall be steel or a UL / FM listed and approved assembly.
- F. When ducts, piping or conduit penetrate the floor of a mechanical room located above an occupied space, such penetrations shall be made completely watertight, such that a liquid leak shall not pass through the penetration.

1.21 FIRE-STOPS AND SEALS

- A. Refer to Division 07 Specification for additional and more specific information.
- B. Fire-stopping systems shall be submitted as shop drawing.
- C. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.
- D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

1.22 CUTTING AND PATCHING

- A. All cutting and patching shall be done per Division 1 requirements. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.
- B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.
- C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members or structural slabs/floors shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.
- D. SCAFFOLDING, RIGGING, HOISTING

1. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises any equipment and apparatus furnished under this Division. Remove same from premises when no longer required.

1.23 EXCAVATION AND BACKFILLING

- A. Excavation and backfilling shall be done per Division 2 of the Specifications.
- B. It is the responsibility of the Contractor to coordinate sizes, depths, fill and bedding requirements and any other excavation work required under this Division per code and local utility requirements.

1.24 WATERPROOFING

- A. Where any work pierces waterproofing, including waterproof concrete and floors in wet areas, the method of installation shall be reviewed by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.25 ACCESSIBILITY AND ACCESS PANELS

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work.
- B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, coil, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.
- C. Access doors in walls, ceilings, floors, etc., shall be field coordinated. It is the responsibility of the Contractor to coordinate and provide information regarding the sizes and quantities of access doors required for his work. The Contractor shall arrange his work in such a manner as to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.
- D. On a clean set of prints, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed.

- E. Upon completion of the Project, the Contractor shall physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels by the installing Contractor at no additional cost to the Owner. All access panel or door locations shall be indicated on Owner's final as-built record drawings.
- F. Permanent ladders for access to equipment when shown on Plans shall be furnished and installed. Coordinate exact requirements in field.

1.26 TEMPORARY OPENINGS

- A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

B. SHUTDOWNS

1. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner's representative.
2. The Architect and the Owner shall be notified of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.
3. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

1.27 TAGS AND CHARTS

- A. Each valve and piece of apparatus under this Division shall be provided with suitable brass or laminated plastic tags securely fastened with brass chains, screws or rivets. Equipment shall be numbered with laminated plastic tags or neatly stenciled letters two (2") inches high using designations in equipment schedules and/or shall conform to a directory indicating number, location and use of each item. Directories shall be prepared under each Section and shall be glass framed.
- B. Directory shall indicate valve tag number and the unit number, floor/area branch line, main line, service or other pertinent data to quickly and easily

identify the valve's purpose.

1.28 ESCUTCHEONS

- A. The Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions in finished visible locations.

1.29 PAINTING

- A. All finish painting in completed areas shall be performed per other divisions of the Specifications.
- B. All materials shipped to the job site under this Division, such as piping, fittings, plumbing fixtures, valves, etc., shall have standard manufacturer's finish, unless otherwise specified by Architect.
- C. All outdoor piping, fittings and hangers shall be properly primed with zinc-rich primer and finished with a minimum of two (2) coats of high grade exterior enamel.

1.30 PIPE EXPANSION

- A. All pipe connections shall be installed to allow for freedom of movement of the piping during expansion and contraction without springing. Provide engineered design, layout, details and fabrication, submitted with registered professional engineer sign and seal, of swing joints, expansion loops and expansion joints with proper anchors and guides. Pay particular attention to plastic piping with high coefficients of expansion.
- B. Consideration of required seismic lateral restraints shall be given when anchoring piping and making provision for expansion.

1.31 ELECTRICAL CONNECTIONS

- A. Unless otherwise specified, all wiring shall be furnished and installed per Division 26 Specifications.
- B. All motor controllers not factory mounted on mechanical equipment shall be furnished, mounted, and installed by the Division 26 contractor, and shall be coordinated with this contractor. Provide properly sized overload heaters and all required accessories with all motor controllers. See Division 26 Motor Controllers for motor controller requirements.
- C. All power wiring shall be furnished and installed per Division 26 complete from power source to motor or equipment junction box including power wiring through the motor controller and proper means of disconnect per NEC and Division 26. The Division 26 Contractor shall provide all disconnects, unless noted otherwise.

1.32 QUIET OPERATION

- A. Equipment and material used in the various systems described herein shall not produce a sound level greater than 55 decibels in the area served. If noise level is deemed objectionable by the Owner/Engineer, the Contractor shall test and record sound levels in the presence of the Owner/Engineer. The sound level shall be observed on the "A" weighting network of a sound level or sound survey meter. The ASHRAE "Guide and Data Book" provides a means to determine sound level of mechanical equipment when the total of background plus equipment sound levels exceeds the minimum acceptable equipment sound level.
- B. If objectionable noises or vibrations of any magnitude are produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

1.33 MAINTENANCE

- A. The Contractor shall provide the necessary skilled labor to assure the proper operation and to provide all required current and preventative maintenance for all equipment and controls provided under this Division until final acceptance of the building by the Owner. The Contractor shall not assume acceptance of the building by the Owner until he receives written notification.
- B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under this Division and he shall take steps to immediately correct any deficiencies that may exist.
- C. The Contractor shall provide a check list and shall put a copy of it in the boiler or main mechanical room. The check list shall itemize each piece of equipment furnished under his Section.
- D. The Contractor shall certify on this check list that he has examined each piece of equipment and that, in his opinion, it is operating as intended by the manufacturer, it has been properly lubricated, and that all necessary current and preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.
- E. The Contractor shall check all controls in the building to ascertain that they are functioning as designed. This shall apply to all thermostats, aquastats, humidistats, freezestats and firestats, etc. This portion of the work shall be performed by the Contractor who installed the controls.
- F. During construction, the Contractor shall ensure that all filters are in place on all equipment. If the equipment is operated during construction (see restrictions section of this specification), strict attention shall be paid to

maintaining clean and effective filters and cleaning ductwork and equipment.

Filters shall be new and/or clean when the system testing and balancing takes place. The Contractor shall bear the cost of all filters and media during construction until final acceptance by the Owner. This requirement shall apply equally to fluid filters and strainers.

- G. Where normal preventative maintenance for any piece of equipment requires special tools, the Contractor shall furnish the appropriate tools for that piece of equipment (i.e., special filter removal hooks, valve wrenches, etc.).

1.34 LUBRICATION

- A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner.
- B. The Contractor shall furnish and install, as appropriate on all equipment requiring lubrication, Zerk pressure gun grease fittings or sight gravity-feed oilers equipped with shutoff and needle valve adjustment.
 - 1. Units furnished with sealed bearings and lifetime lubrication are exempted.
 - 2. All fittings and oilers are to be fully accessible for lubrication with equipment which does not require special adapters.
 - 3. Where fittings would be otherwise inaccessible, furnish and install extended grease lines.

1.35 CLEANING

- A. The Contractor shall be responsible for keeping the jobsite clean, safe and neat throughout the duration of construction. The Contractor shall clean up his own debris daily and shall coordinate removal of rubbish and debris with the General Contractor/Construction Manager.
- B. No debris, construction materials, cigarette butts, coffee cups, etc., shall be left above suspended ceilings.
- C. Terminal equipment and plumbing fixtures shall be cleaned at substantial completion.
- D. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired.

or replaced when the system is reconnected at no additional cost to the Owner.

- E. During the course of construction, all pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.
- F. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

1.36 OPERATING INSTRUCTIONS

- A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least 72 hours notice to the Owner, Engineer, and Commissioning Agent in advance of this period.
 - 1. Prior to the instruction period, the contractor shall have approved Owner's Manuals on site for aiding in the instructions.
- B. The Contractor shall formally submit for delivery to the Engineer a minimum of three (3) Owner's Manuals, to be complete bound sets of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Division. All instructions shall be submitted in draft for review prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instruction.
- C. The Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this Division.
- D. The appropriate Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.
- E. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. These letters will be bound into the operating and maintenance books.
- F. Refer to individual trade Sections for any other particular requirements related to operating instructions.

1.37 ADJUSTING AND TESTING

- A. Prior to factory start-up procedures, the Contractor shall perform prefunctional checks and procedures to ensure that the equipment is installed properly and are operational.
 - 1. The prefunctional checklists and procedures are to be provided by the Commissioning Agent. These forms must be filled out and approved before final start-up and adjustments are made by the factory representative.
- B. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer and the Commissioning Agent that they are in proper adjustment, the controls operate as described in the sequence of operation and all systems are in satisfactory, permanent operating condition.
- C. A factory service engineering representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment.
 - 1. The following equipment will require this inspection: pumps, equipment, water temperature controls and valves, water heaters, specialized plumbing fixtures, and electric/electronic faucets and flush valves.
 - 2. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.
 - a. The written notification shall include a complete start-up report on manufacturer's letterhead with all information including date and signature.
 - b. The report shall be made available to the Engineer and Commissioning Agent for review before acceptance is granted.

1.38 GUARANTEES

- A. The Contractor shall guarantee all equipment, material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner, unless otherwise noted.

- B. All refrigeration compressors shall have five (5) year guarantee from the date of final acceptance by the Owner unless otherwise noted.
- C. All water heaters shall have an optional minimum five (5) year guarantee from the date of final acceptance by the Owner unless otherwise noted.
- D. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

1.39 RESTRICTIONS

- A. Water heaters provided under this Division may not be used for temporary hot water requirements due to premature wear and dirt/dust infiltration. Written approval may be obtained from the Owner only after submission of a written cleaning plan and guarantee/warranty extension.
- B. Piping shall not be run in any concrete floor slab. Written approval from the Structural Engineer may be obtained only after submission and approval of a layout shop drawing.

PART 2 PRODUCTS - NOT USED.

PART 3 EXECUTION - NOT USED.

END OF SECTION 22 05 00 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

2.2 PIPE-SLEEVE SEALS

- A. Sealing Compounds:
 - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 - 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- B. Pipe Sleeve Material:
 - 1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 - 2. Masonry Structures: Sheet metal or fiber.
- C. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- E. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.

- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 220517

SECTION 220519 - METERS AND GAUGES 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 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Pressure gauges.

1.3 RELATED REQUIREMENTS

- A. Section 232113 - Hydronic Piping.

1.4 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

1.5 SUBMITTALS

- A. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

- A. Pressure Gauges shall be as equal to "WIKA" Type 213.53.
- B. Bourdon Tube for Liquids and Gases:
 - 1. Case: Stainless Steel
 - 2. Size: 4" Dial.
 - 3. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.
 - 4. Scale: Psi - {Selected for complete range of system operation}.

2.2 PRESSURE GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Omega Engineering, Inc: www.omega.com/#sle.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

B. Thermometers shall be as equal to "WIKA" Type T19010302008XWI.

C. Thermometer: ASTM E 1, 360 degree adjustable angle with locking nut, blue liquid filled (non- mercury), V-Shaped polyester Case with glass window.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.
- B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.
- C. Locate PT (pressure-temperature) test plugs adjacent to control device sockets.

3.2 SCHEDULES

A. Pressure Gauges, Location and Scale Range:

1. Gas regulators (Natural/LP), High Pressure - 0 to 10 psi., Low Pressure - 0 to 14"w.c.
2. Domestic water pressure reducing valves, 0 to 120 psi.

B. Stem Type Thermometers, Location and Scale Range:

1. Headers to central equipment, 0 to ____ degrees F.
2. Domestic hot water supply, 0 to 180 degrees F.

C. Thermometer Sockets, Location:

1. Control valves 1 inch & larger - inlets and outlets.

END OF SECTION 220519 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Lubricated plug valves.

1.2 RELATED REQUIREMENTS

- A. Section 083100 - Access Doors and Panels.
- B. Section 220553 - Identification for Plumbing Piping and Equipment.
- C. Section 220719 - Plumbing Piping Insulation.
- D. Section 221005 - Plumbing Piping.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support

requirements, and piping connections.

- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Town of Trumbull's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Town of Trumbull with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.5 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.

2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.7 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 1. Shutoff: Ball, butterfly, gate or plug.
 2. Swing Check (Pump Outlet):
 - a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 inch and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
 - c. 2-1/2 inch and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:
 1. Steel Pipe:
 - a. 2 inch and Smaller: Threaded ends.
 - b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.

- c. 5 inch and Larger: Grooved or flanged ends.
- 2. Copper Tube:
 - a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 inch and Larger: Grooved or flanged ends.

2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 inch and smaller except plug valves.
 - 4. Wrench: Plug valves with square heads.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: 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: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.

3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
 4. Solder Joint Connections: ASME B16.18.
 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 2. Solder-joint Connections: ASME B16.18.
 3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.
- 2.3 BRONZE, ANGLE VALVES
- A. Class 125; CWP Rating: 200 psi:
1. Comply with MSS SP-80, Type 1.
 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 3. End Connections: Pipe thread.
 4. Stem: Bronze.
 5. Disc: Bronze.
 6. Packing: Asbestos free.
 7. Handwheel: Bronze or aluminum.
- 2.4 BRASS, BALL VALVES
- A. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.

3. CWP Rating: 600 psi.
4. Body: Forged brass.
5. End Connections: Pipe thread.
6. Seats: PTFE.

2.5 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Wafer Style:

1. Class 125, or Class 150 flanges.
2. Comply with MSS SP-67, Type I.
3. Wafer Style, Service Pressure Ratings:
 - a. 150 psi for sizes 14 to 24 inch.
4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
5. Stem: One or two-piece stainless steel.
6. Seat: EPDM.
7. Disc: Aluminum-bronze.
8. Finish: Epoxy coated.
9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.6 BRONZE, SWING CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WOG Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded.

6. Disc: Bronze.

2.7 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Spring-Closure Control.

1. Comply with MSS SP-71, Type I.
2. Description:
 - a. CWP Rating: 200 psi.
 - b. Design: Clear or full waterway.
 - c. Body: ASTM A126, gray iron with bolted bonnet.
 - d. Ends: Flanged as indicated.
 - e. Trim: Bronze.
 - f. Gasket: Asbestos free.
 - g. Closer Control: Factory installed, exterior lever, and weight.

2.8 LUBRICATED PLUG VALVES

A. Regular Gland with Flanged Ends:

1. Comply with MSS SP-78, Type II.
2. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
3. Pattern: Regular or short.
4. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

- D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Lift Check: Install with stem plumb and vertical.
 - 2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Pipe rollers and roller supports.
- F. Pipe supports, guides, shields, and saddles.
- G. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

1.3 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications.

1.4 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- F. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2014).

- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- I. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- K. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- L. FM (AG) - FM Approval Guide; current edition.
- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- N. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Wiles Architects of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for .
- C. Shop Drawings: Include details for fabricated hangers and supports.

1.7 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 055000.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

- a. Substitutions: See Section 016000 - Product Requirements.
- b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- 2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
- 3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- B. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
 - 2. Minimum Size, Unless Otherwise Indicated or Required:

- a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Trapeze Support for Multiple Pipes: 3/8 inch in length.
 - C. Channel Nuts:
 - 1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.
- 2.2 BEAM CLAMPS
- A. Manufacturers:
 - 1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - 2. FNW; 7201: www.fnw.com/#sle.
 - 3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
 - 5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 - C. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 - D. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 - E. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 - F. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 - G. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- 2.3 PIPE HANGERS
- A. Band Hangers, Adjustable:
 - 1. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

B. J-Hangers, Adjustable:

1. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.

C. Swivel Ring Hangers, Adjustable:

1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.

D. Clevis Hangers, Adjustable:

1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
2. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
3. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.4 PIPE CLAMPS

A. Riser Clamps:

1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

2.5 PIPE ROLLERS AND ROLLER SUPPORTS

- A. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
- B. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.6 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Pipe Supports:

1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
- C. Pipe Supports, Thermal Insulated:
1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Provide pipe supports for 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
 2. PVC Jacket:
 - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
 - b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Minimum Thickness: 60 mil, 0.06 inch.

2.7 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Materials for Metal Fabricated Supports: Comply with Section 055000.
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- F. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
 - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.8 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

- A. Prefabricated Trapeze-Framed Metal Strut Systems:
 - 1. Manufacturers:
 - a. Anvil International, LLC: www.asc-es.com/#sle.
 - b. --THE FOLLOWING MANUFACTURER HAS REGIONAL AVAILABILITY--
 - c. Gripple, Inc; Fast Track - Standard: www.gripple.com/#sle.
 - d. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
 - f. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
 - 3. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
 - 4. Strut Channel or Bracket Material:

- a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
- b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
- 6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- 7. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

2.9 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:

- 1. Manufacturers:
 - a. ABB Installation Products; _____: electrification.us.abb.com/#sle.
 - b. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc; _____: www.unistrut.com/#sle.

2.10 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

- 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
- 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
- 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
- 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

- C. Pipe Shields for Insulated Piping:
 - 1. General Construction and Requirements:
 - a. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- D. Anchors and Fasteners:
 - 1. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - c. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types properly suited for the specific applications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Wiles Architects, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Wiles Architects, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of

the piping system.

G. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Remove temporary supports when no longer required.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

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 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Nameplates.
- B. Tags.

1.3 RELATED REQUIREMENTS

- A. Section 099123 - Painting and Coating: Identification painting.

1.4 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.5 SUBMITTALS

- A. See Section 013300 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit (2) valve charts and schedules, including valve tag number, location, function, and valve manufacturer's name and model number. Charts and schedules shall be mounted within mechanical areas served, and shall also be permanently bound and submitted with O&M manuals and 'As-Built' documents.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Piping: Markers, Tags.
- B. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Champion America, Inc: www.Champion-America.com.
- C. Seton Identification Products: www.seton.com/aec.

2.3 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc.: www.pipemarker.com/#sle.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
- B. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.

2.4 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving:
www.advancedgraphicengraving.com/#sle.
 - 2. Brady Corporation: www.bradycorp.com/#sle.
 - 3. Brimar Industries, Inc.: www.pipemarker.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Chart & Schedules: Typewritten letter size list in anodized aluminum frame.

2.5 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.

2. Brimar Industries, Inc.: www.pipemarker.com/#sle.
 3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com/#sle.
 4. Seton Identification Products: www.seton.com/#sle.
- B. Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, self-adhesive plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Color code as follows:
1. Potable Water: Green with white letters.
 2. Flammable Gasses and Fluids: Yellow with black letters.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 099123 for stencil painting.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Use tags on piping 3/4 inch diameter and smaller.
1. Identify service, flow direction, and pressure.
- E. Identify control panels and major control components outside panels with plastic nameplates.
- F. Identify valves in main and branch piping with tags.
- G. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch outside diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or

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Project No. 20-080

enclosure, and at each obstruction.

END OF SECTION 220553 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 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Piping insulation for all new water piping
- B. Glass fiber insulation.
- C. Jacketing and accessories.

1.3 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.4 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010.
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- D. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. Knauf Insulation: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
 - 1. Compatible with insulation.

2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
3. K-Flex USA LLC; Insul-Tube: www.kflexusa.com/#sle.

2.4 VALVE AND FITTING JACKETS

A. PVC Plastic Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
2. Covering Adhesive Mastic: Compatible with insulation.
 - a. Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible

connections, pump bodies, roof drain bodies, and expansion joints.

- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids over 90 degrees F, insulate flanges and unions at equipment.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
 - 1. Application: Piping 1 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- J. All piping exposed in finished spaces: Finish with PVC jacket and fitting covers.

- K. Install PVC protective jackets on all piping in mechanical and utility, service, or storage rooms less than 10'-0" Above Finished Floor.
- L. Wet Applications: Provide PVC jacket on all piping located within wet areas with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. aluminum jackets are not acceptable.

3.3 SCHEDULES

- A. Plumbing Systems:
 - 1. Domestic Cold Water, Hot Water:
 - a. All Sizes - Glass Fiber Insulation; 1" Thickness
 - 2. Piping Within Cavities of Concrete Block Walls
 - a. Cellular Foam Insulation:
 - 1) Pipe Size Range: 1/2-1 inch.
 - 2) Thickness: 1/2 inch.
 - 3. Domestic Hot Water Recirculation:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: All sizes.
 - 2) Thickness: 1 inch.

END OF SECTION 220719 220719

SECTION 220719.11 - UNDER-LAVATORY PIPE AND SUPPLY COVERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Under-lavatory pipe and supply covers.

PART 2 PRODUCTS

2.1 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Basis of Design: Plumberex Specialty Products, Inc;
www.plumberex.com/#sle.
- B. General:
 - 1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks per ADA Standards.
 - 2. Adhesives, sewing threads, and two-ply laminated materials are prohibited.
 - 3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls, floor finishes, lavatories, and piping are prepared and ready for installation of under-lavatory guards.
- B. Confirm location and size of fixtures and piping before installation.

3.2 INSTALLATION

- A. Install under-lavatory guards according to manufacturer's written instructions..

3.3 CLEANING

- A. Clean installed under-lavatory guards.

3.4 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 220719.11

SECTION 221005 - PLUMBING PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Plumbing Vent
 - 3. Domestic water.
 - 4. Pipe hangers and supports.
 - 5. Valves.
 - 6. Check.
 - 7. Relief valves.
 - 8. Strainers.

1.3 RELATED REQUIREMENTS

- A. Section 220719 - Plumbing Piping Insulation.

1.4 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2011.
- D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.
- E. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

- F. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.
- G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- I. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.
- J. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2009.
- K. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2011.
- L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- M. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
- N. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- O. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- P. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.5 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Project Record Documents: Record actual locations of valves.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Connecticut, standards.
 - 1. Maintain one copy on project site.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

- C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of Connecticut plumbing code.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 SANITARY SEWER AND VENT PIPING, BURIED, WITHIN OR TO 5 FEET OF BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel, heavy duty clamp and shield assemblies.

2.3 SANITARY SEWER AND VENT PIPING ABOVE SLAB

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel, heavy duty clamp-and-shield assemblies.
- B. Copper Tube: ASTM B306, DWV.
 - 1. Fittings: ASME B16.29, wrought copper or ASME B16.32 solvent.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.4 WATER PIPING

- A. Copper Tube: ASTM B88 (ASTM B88M), Type [CHOICE TEXT], Hard Drawn

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Solder Joints: ASTM B32, alloy Sn95 solder.
3. Mechanical Joints: Copper press fittings as manufactured by Viega or Rigid Tool Co.
 - a. Press fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.

2.5 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
- B. Manufacturers
 1. Anvil International Inc.
 2. Tolco Inc.
 3. Beeline Products
- C. Plumbing Piping - Waste, Sanitary, Vent:
 1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Anvil, fig. 104, Malleable iron, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Anvil, fig. 260, Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Anvil, fig. 46, Steel channels with welded spacers and hanger rods.
 5. Vertical Support: Anvil, fig. 261, Steel riser clamp.
 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

7. Beam Clamps: Anvil, fig. 95, Carbon steel clamp, hardened steel cup, set screw and locknut, fig. 96 retaining clip.
8. Threaded rod: Carbon steel, threaded complete length, size to load.

D. Plumbing Piping - Water:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Anvil, fig. 65, Malleable iron, adjustable swivel, split ring.
3. Vertical Support: Anvil fig. 261, Steel riser clamp.
4. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or plastic coated.

2.6 BALL VALVES

A. Manufacturers:

1. Nibco, Inc: www.nibco.com.
2. Milwaukee Valve Company: www.milwaukeevalve.com.
3. Viega LLC: www.viega.com/#sle.
4. Watts Regulator Co.
5. Apollo Valve

- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends or press fit.

2.7 SWING CHECK VALVES

A. Manufacturers:

B. Up to 3 Inches:

1. Nibco, Inc: www.nibco.com.
2. Milwaukee Valve Company: www.milwaukeevalve.com.
3. Watts Regulator Co.
4. Apollo Valve
5. Viega LLC: www.viega.com/#sle.

- C. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, threaded or grooved ends.

2.8 RELIEF VALVES

2.9 STRAINERS

A. Manufacturers:

- 1. Armstrong International, Inc: www.armstronginternational.com/#sle.
- 2. Green Country Filter Manufacturing: www.greencountryfilter.com/#sle.
- 3. WEAMCO: www.weamco.com/#sle.

B. Size 2 inch and Under:

- 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 1-1/2 inch to 4 inch:

- 1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

2.10 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers:

- a. Amtrol Inc. : www.amtrol.com
- b. Bell & Gossett : www.bellgossett.com.

B. Temperature and Pressure Relief:

2.11 STRAINERS

A. Manufacturers:

- 1. SAFECO Manufacturing: www.safeco-mfg.com.
- 2. Watts Regulator: wattsreg.com.

B. Size 2 inch and Under:

1. Class 150, solder joint, bronze body for 175 psi CWP, Y pattern with 20 mesh stainless steel perforated screen.
- C. Size 2-1/2 inch and greater:
 1. Manufacturers:
 - a. Keckley Model F-150.
 2. Class 150, threaded body, Y pattern with 3/64 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed. Coordinate access doors with architectural drawings for size and location.

- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Ball valve handles shall allow for full range of operation.
- N. Install water piping to ASME B31.9.
- O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- P. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Provide copper plated hangers and supports for copper piping.
 - 7. Prime coat exposed steel hangers and supports. Refer to Section 099000. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - 8. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 220548.
 - 9. Support cast iron drainage piping at every joint.
- Q. Press Connections:
 - 1. Copper press fittings shall be made in accordance with the manufacturers installation instructions.

2. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting.
3. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting.
4. The joints shall be pressed using the tool approved by the manufacturer.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide flow controls in water recirculating systems where indicated.

3.5 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.
- C. Vent Piping: Slope vent piping to drain back to drainage system

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for bacterial, sediment, etc. in accordance with state quality standards at minimum 10 percent of outlets.

- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze through an independent laboratory in accordance with AWWA C651 and the local Department of Public Health requirements. Provide written lab reports for each outlet tested. If samples do not pass bacteriological testing, flush and repeat disinfection, and retest.
- I. All repeat retesting shall be done at no cost to the Owner.

3.7 SERVICE CONNECTIONS

- A. Provide new or extend existing sanitary sewer services as shown on the plans. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Water service is new as shown on the site and plumbing plans. Provide new meter spacer and valving with approved main shut-off gate valve, reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve and strainers. , and sand strainer.
 - 1. Refer to plans for piping details at building entry.
 - a. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

3.8 TESTING

- A. Before any water, waste, sanitary, vent or storm piping is covered up, it shall be approved by the authority having jurisdiction and shall pass all testing described herein.
- B. Air pressure testing will not be allowed.
- C. Sanitary, Waste Piping
 - 1. Piping shall be hydrostatically tested to 10 ft of head for a minimum of 4 hours with no discernible loss of water.
 - 2. Testing shall be done either in sections or as a whole.

3. If there is reasonable doubt of watertightness, a smoke test shall be performed.

D. Water Piping

1. New piping in substantial sections shall be hydrostatically tested with potable water to 125 psi or 1-1/2 times the operating pressure of the system, whichever is greater.
2. Small sections of new piping shall be visually checked for leakage only.
3. A pressure gauge shall be provided in the piping. The gauge shall be a minimum 4" dial face in 2 Psi increments.
4. Minimum test time shall be 4 hours with a maximum loss of 2 psi.
5. Do not test piping using valves or through valves that have been installed. Cap branch piping for testing.

E. Test Results

1. Results of the testing shall be submitted in writing and signed by the contractor doing the work, and submitted to the Engineer of record.
2. If any section or joint of the piping fails the test, the contractor shall repair the leak and any associated damaged areas caused directly by the leak at no cost to the Owner.

3.9 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:
 - a. Pipe size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum hanger spacing: 6.5 ft.
 - 2) Hanger rod diameter: 3/8 inches.
 - b. Pipe size: 1-1/2 inches to 2 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 3/8 inch.
 - c. Pipe size: 2-1/2 inches to 3 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 1/2 inch.

- d. Pipe size: 4 inches to 6 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 5/8 inch.
- 2. Plastic Piping:
 - a. All Sizes:
 - 1) Maximum hanger spacing: 6 ft.
 - 2) Hanger rod diameter: 3/8 inch.

END OF SECTION 221005 221005

SECTION 221006 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Floor drains
- B. Cleanouts.
- C. Hose bibbs.
- D. Double check valve assemblies.
- E. Water hammer arrestors.
- F. Sanitary waste interceptors.
- G. Thermostatic mixing valves.

1.3 RELATED REQUIREMENTS

- A. Section 016000 - Product Requirements: Procedures for [Owner]-supplied products.
- B. Section 221005 - Plumbing Piping.
- C. Section 224000 - Plumbing Fixtures.
- D. Section 223000 - Plumbing Equipment.

1.4 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- C. ASSE 1011 - Hose Connection Vacuum Breakers; 2004.
- D. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
- E. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

- F. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.5 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 FLOOR DRAIN :

- A. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
- B. Refer to drawings for Manufacturer, model number and size.

2.3 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
 - 2. Josam Company: www.josam.com/#sle.
 - 3. Zurn Industries, Inc: www.zurn.com/#sle.
 - 4. Wade
- B. Cleanouts at Exterior Surfaced Areas :

- C. Cleanouts at Interior Finished Floor Areas :
- D. Cleanouts at Interior Finished Wall Areas:
- E. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type.
Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 HOSE BIBBS

- A. Manufacturers:
 - 1. Woodford
 - 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
 - 3. Watts Regulator Company: www.wattsregulator.com/#sle.
- B. Exterior Hose Bibbs:
 - 1. ASSE 1019; freeze resistant, self-draining type with polished bronze lockable recessed box hose thread spout, lockshield and removable key, and integral vacuum breaker.

2.5 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers:
 - 1. Apollo Valves: www.apollovalves.com/#sle.
 - 2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Double Check Valve Assemblies:
 - 1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.6 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Precision Products
 - 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
 - 3. Watts Regulator Company: www.wattsregulator.com/#sle.
- B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.7 SANITARY WASTE INTERCEPTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company; _____: www.jrsmith.com/#sle.
2. Zurn Industries, LLC; _____: www.zurn.com/#sle.
3. Schier

B. Grease Interceptors:

1. Construction:
 - a. Rough-in: On floor.
 - b. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port, recessed for floor finish.

2.8 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:
 - a. Symmons
 - b. Powers
 - c. Acorn
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
 - a. Check valve on inlets.
 - b. Stem thermometer on outlet.
 - c. Strainer stop checks on inlets.

PART 3 EXECUTION

3.1 INSTALLATION

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

- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, washing machine outlets, quick closing valves, midpoints and ends of banks of fixtures.

END OF SECTION 221006 221006

SECTION 221250 - 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 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for gas piping systems.
 - 1. Natural Gas.
 - 2. Regulators and safety devices for Natural Gas systems

1.3 RELATED SECTIONS

- A. Section 220510 - PLUMBING GENERAL CONDITIONS
- B. Section 22 10 05 - Plumbing Piping
- C. Section 22 30 00 - Plumbing Equipment

1.4 REFERENCES

- A. Connecticut Fuel Gas Code
- B. NFPA 54
- C. ANSI Z223.1
- D. CSA / AGA Standards
- E. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- F. ANSI/ASME B36.10 Welded and Seamless Wrought-Steel pipe
- G. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- H. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose, Inch

1.5 SYSTEM DESCRIPTION

- A. Provide piping from the gas meter as shown on the plans.
- B. Provide gas piping, including fittings and valves to form a complete system.

1. Piping includes connections to equipment shown on the plans or provided by others.
2. Provide any required gas regulators at equipment connections for reductions in pressure. Coordinate with all other trades for requirements of equipment.

1.6 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Piping and fittings
 1. Product Data: Provide Manufacturers literature.
 2. Shop Drawings: Indicate all catalog data.
- C. Equipment and Valving
 1. Product Data: Provide Manufacturers literature.
 2. Shop Drawings: Indicate all catalog data.
- D. Test Reports: Indicate final testing, inspection and approval reports by the AHJ and/or the service utility.
- E. Certificates: Certify that products of this section meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

- A. Perform in accordance with Connecticut Fuel Gas Code standard, State of Connecticut Building Code.
 1. Maintain one copy of codes and standards on project site.
- B. Requirements of the service Utility
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.
- E. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- F. All valves, regulators, etc. shall be tested and rated for respective natural gas applications by UL and CSA.

1.8 PROJECT CONDITIONS

- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Metallic pipe: Steel, schedule 40, ASTM A53
- B. Metallic pipe fittings: malleable iron.
- C. Piping shall be threaded up to and including 2" in diameter.
- D. Piping over 2" in diameter shall be welded

2.2 ACCESSORIES

- A. Shutoff Valves
 - 1. Plug type - Heavy duty, iron body construction, flat head type with brass plug and washer, CSA / UL tested and approved
 - 2. Ball type - Bronze body, chrome plated ball, brass stem, PTFE seat, stem packing and bearing CSA/UL tested and approved for flammable gas.
 - 3. Strainer - Bronze body, CSA/UL tested and approved

PART 3 EXECUTION

3.1 PIPING - GENERAL

- A. The service entrance of the gas pipe to the building shall be provided with a line size, CSA/UL tested and approved shut-off plug valve. The valve shall be lockable open or shut with a standard padlock.
- B. Ream ends of pipe free from burrs. Keep free of scale, dirt and oil. Piping shall be blown out with compressed air.
- C. Pipe threads shall be tapered in compliance with ANSI/ASME B1.20.1. Apply pipe joint compound to male threads only.
 - 1. Threaded pipe shall be used for piping of 2" or less. All piping larger than 2" shall have welded fittings and joints.
- D. Provide couplings for pipe size transitions and for joining lengths of pipe. Bushings shall not be used.

3.2 PIPING INSIDE BUILDINGS

- A. Do not cut, notch or drill through beams or joists to install piping.
- B. Slope piping upwards towards risers or equipment at not less than 1/4" in 15 feet.
- C. Piping shall not be installed in concealed locations except with the use of elbows, tees and couplings.
 - 1. Where fittings are inserted in the piping, the pipe shall be reconnected by welding, flanges or a ground joint union.
 - 2. Valves shall not be installed in concealed locations.
- D. Where piping is installed in partition walls, a steel striker plate is to be provided the full length of the concealed pipe run
- E. Changes in direction shall be made by the use of fittings, factory or field bends.
 - 1. Bends shall be made only with bending equipment and shall be free from buckling, cracks or other damage.
 - 2. Pipe shall not be bent more than 90° with the inside radius not less than 6 times the outside diameter of the pipe.
- F. Provide drips at all risers or low points in the system. Drips are to be readily accessible for cleaning or emptying and are not to be used for supporting the piping.
- G. Provide plug type gas cocks in pipe branch lines and connections to equipment and cap until ready for connection to equipment.
 - 1. Ball type shutoffs will be acceptable in branch lines off mains
- H. All exposed gas piping exterior to and/or inside the building shall be painted with primer and two coats of yellow paint and pipe markers provided at changes in direction and at maximum 6'-0" intervals.
- I. Branch piping is to be connected from top or side of horizontal piping.
- J. Maximum hanger spacing:
 - 1. 1/2" pipe -6 feet
 - 2. 3/4" to 1" pipe -8 feet
 - 3. 1¼" and larger pipe -10 feet

3.3 PIPING OUTSIDE THE BUILDINGS (EXPOSED, NOT BURIED)

- A. Slope piping upwards towards risers or equipment at not less than 1/4" in 15 feet.
- B. Piping shall not be installed in concealed locations except with the use of elbows, tees and couplings.
 - 1. Where fittings are inserted in the piping, the pipe shall be reconnected by welding, flanges or a ground joint union.
 - 2. Valves shall not be installed in concealed locations.
- C. Changes in direction shall be made by the use of fittings, factory or field bends.
 - 1. Bends shall be made only with bending equipment and shall be free from buckling, cracks or other damage.
 - 2. Pipe shall not be bent more than 90° with the inside radius not less than 6 times the outside diameter of the pipe.
- D. Provide drips at all risers or low points in the system. Drips are to be readily accessible for cleaning or emptying and are not to be used for supporting the piping.
 - 1. Where drips could be subject to freezing, the AHJ may authorize the drips to be deleted.
- E. Provide plug type gas cocks in pipe branch lines and connections to equipment and cap until ready for connection to equipment.
 - 1. Ball type shutoffs will be acceptable in branch lines off mains
- F. All exposed gas piping outside the building shall be painted with primer and two coats of yellow paint and pipe markers provided at changes in direction and at 10'-0" intervals.
- G. Branch piping is to be connected from top or side of horizontal piping.
- H. Maximum roof support spacing:
 - 1. 1/2" pipe -4 feet
 - 2. 3/4" to 1" pipe -6 feet
 - 3. 1¼" and larger pipe -8 feet
 - 4. Within 12" either side of bends, valves and regulators.

3.4 TESTING

- A. All piping, new and existing, shall be tested and shall be in compliance with NFPA-54 with records of inspection and tests performed.
- B. Test medium shall be compressed air or other inert gas.
- C. Test pressure shall be 1-1/2 times the maximum working pressure but not less than 3 PSIG. Duration shall be ½ hour for each 500 cubic feet of pipe or fraction thereof.
 - 1. Piping shall be tested without valves installed.
 - 2. Valves are not to be used as a bulkhead between gas in one section of pipe and test medium in another.
- D. Provide gauges or a manometer of increments not greater than 1/10 pound. Soap solution shall be used at joints or fittings.
 - 1. Pressure gauges shall be permanently installed downstream from each line pressure regulator.
- E. After turning on the gas the piping shall be purged of all test medium and the system shall again be checked for leakage.
- F. The gas utility shall be the governing authority and shall be presented with copies of tests results and records. All rules and regulations must be complied with and coordinated to insure a safe installation.
- G. If any part of the gas system is defective or not in compliance with this specification the contractor shall repair or replace the items at no cost to the Owner.

3.5 REGULATORS

- A. Provide regulators as required for primary service and secondary for equipment and appliances. Regulators to be sized and specified by a qualified manufacturers representative and submitted for review.
- B. Set primary regulator at no more than 14" W.C., specific equipment requirements and/ or as required by local Gas Co.
- C. Set secondary regulators as necessary for appliances and equipment.
- D. Vent regulators and other equipment to exterior of building and terminate with suppressor.
 - 1. Vents shall be run independently of each other and shall be field located.

- E. Provide strainers on the inlet of each line pressure regulator or electrically operated valve.
- F. Provide a shut-off valve upstream of each gas pressure regulator

3.6 EQUIPMENT CONNECTORS

- A. Connectors shall have a plug type shut-off gas cock or rated ball valve installed in rigid tubing in an accessible location upstream of the connector.
 - 1. Flexible connectors of semi-rigid stainless steel with polyethylene jacket may be used for connecting appliances to the shut-off valve.
 - 2. All connectors shall be provided with a drip leg, full line size.
- B. Connectors shall be made from the top or side of horizontal lines.
- C. Provide unions for connectors at gas-cocks and equipment.
- D. Connectors to kitchen equipment are to be the "quick disconnect" type.

END OF SECTION 221250 221250

SECTION 221429 - SUMP PUMPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Submersible sump pumps.

1.3 REFERENCE STANDARDS

- A. ICC (IPC) - International Plumbing Code; 2015.
- B. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 QUALITY ASSURANCE

- A. Certifications: UL (DIR) listed, classified, and suitable for the purpose specified and indicated.
- B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for pumps and related components. Complete forms in Town of Trumbull's name and register with manufacturer.
- C. Submit warranty with related forms completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. General: Rugged stainless steel and cast iron housing and base with oil-filled motor chamber, ball bearings, and mechanical seal.
- B. Impeller: Thermoplastic; open nonclog, stainless steel shaft.
- C. Motor: Base mount, enclosed, lubricated oil-free, thermal-overload protected, continuous duty, permanent split capacitor with oil-resistant, three-prong connector, 10 foot power cord.
- D. Controls: Integral, chemically-resistant, vertical plated-steel rod float switch. Cycle pump Off/On between 2.5 and 9 inch heights from bottom of pump.
- E. Solids Handling Capacity: Pass lint and other small solids up to 1/2 inch in size.
- F. Discharge Pipe Size: 2 inch, NPT, female.
- G. Maximum Water-Based Effluent Temperature: 120 degrees F.
- H. Accessories: Provide full flow swing-type discharge check valve.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products with related fittings and accessories according to manufacturer instructions.
- B. Observe and provide incidentals required to complete installation in compliance with ICC (IPC).

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Operational Tests: Conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.3 CLEANING

3.4 PROTECTION

- A. Protect installed products from damage from subsequent construction operations.

END OF SECTION 221429

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Water Heaters:
 - 1. Commercial gas fired.
- B. In-line circulator pumps.
- C. Submersible sump pumps.
- D. Compression tanks.

1.3 RELATED REQUIREMENTS

- A. Section 01 91 13 - General Commissioning Requirements.
- B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.4 REFERENCE STANDARDS

- A. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2014.
- B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.
- C. CSA P.3 - Testing Method for Measuring Energy Consumption and Determining Efficiencies of Gas-Fired Storage Water Heaters; 2004 (Reaffirmed 2015).
- D. ICC (IPC) - International Plumbing Code; 2015.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittals Procedures.
- B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 2. Indicate pump type, capacity, power requirements.
 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Town of Trumbull's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.7 CERTIFICATIONS

- A. Water Heaters: NSF approved.
- B. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide Min. 7 year manufacturer warranty, plus a one year "No-Cost" service policy for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATER MANUFACTURERS

- A. A.O. Smith Water Products Co: www.hotwater.com.
- B. State Industries
- C. Rheem Manufacturing Company: www.rheem.com.
- D. Substitutions: Request must be in writing within 60 days of Contract Award. See Section 016000 - Product Requirements.
 - 1. All alternative and/or approved water heaters (with tanks) that require more floor area, more electrical connections, etc. will be the complete responsibility of the proposing contractor for any additional cost or time and determining the location of installing a heater with storage tank.

2.2 COMMERCIAL GAS FIRED WATER HEATERS

- A. Type: Automatic, natural gas-fired, vertical storage, condensing type
- B. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
- C. Tank: welded steel ASME labelled and stamped; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches , encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and skid mounted.
- D. Accessories: Provide:
 - 1. Water Connections: Brass.
 - 2. Dip tube: Brass.
 - 3. Drain Valve: Brass
 - 4. Anode: Magnesium.

5. Pressure/Temperature Relief Valve
 6. Condensate Neutralization System
 - E. Controls: Graphic digital burner control panel, automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, manual reset high temperature limiting thermostat factory set at 140 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, .
- 2.3 DIAPHRAGM-TYPE COMPRESSION TANKS
- A. Manufacturers:
 1. Amtrol Inc: www.amtrol.com/#sle.
 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 3. Taco, Inc: www.taco-hvac.com/#sle.
 4. Wessels
 - B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
 - C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 5 PSIG
- 2.4 WET ROTOR IN-LINE CIRCULATOR PUMPS
- A. Manufacturers:
 1. Grundfos
 2. Armstrong Pumps Inc: www.armstrongpumps.com/#sle.
 3. ITT Bell & Gossett: www.bellgossett.com/#sle.
 4. Taco Pumps
 - B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
 1. Stainless Steel is acceptable
 - C. Impeller: Bronze or stainless steel.

- D. Shaft: Alloy stainless steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: EPDM o-rings
- F. Drive: Flexible or direct drive coupling.
- G. Provide either separately or integral to the pump a 24 hour timeclock
- H. Provide aquastat controller and sensor

2.5 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
 - 1. Liberty
 - 2. Zoeller
 - 3. Hydromatic
- B. Type: Completely submersible, vertical, centrifugal.
- C. Casing: Cast iron pump body and oil filled motor chamber.
- D. Impeller: Cast iron; open non-clog, stainless steel shaft.
- E. Bearings: Ball bearings.
- F. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.
- G. Controls: Integral diaphragm type level controls with separate liquid level control high level alarm.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Pumps:
 - 1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION 223000 223000

SECTION 224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Flush valve water closets.
- B. Bidets.
- C. Wall hung urinals.
- D. Lavatories.
- E. All-in-one lavatory system.
- F. Under-lavatory pipe supply covers.
- G. Electric water coolers.
- H. Bi-level, electric water coolers.

1.3 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.
- B. Section 221006 - Plumbing Piping Specialties.

1.4 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- C. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.
- D. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2004.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

- G. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Manufacturer's Instructions: Indicate installation methods and procedures.
- E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, etc.

2.2 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.

- C. Perform work in accordance with local health department regulations.
- D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.3 TANK TYPE WATER CLOSETS

- A. Manufacturers:
 - 1. American Standard Inc: www.americanstandard.com.
 - 2. Kohler Company: www.kohler.com/#sle.
 - 3. Toto
- B. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, close-coupled closet combination with elongated rim, fittings and lever flushing valve, bolt caps. Maximum Water Consumption at 1.28 gallon per flush.
- C. Seat: Solid white plastic, open front, brass bolts, without cover.

2.4 WALL HUNG URINALS

- A. Manufacturers:
 - 1. American Standard Inc: www.americanstandard.com.
 - 2. Toto
 - 3. Kohler Company: www.kohler.com
- B. Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
 - 1. Flush Volume: 0.5 gallon, maximum.
 - 2. Flush Valve: Exposed (top spud).
 - 3. Flush Operation: Manual, oscillating handle.
 - 4. Trapway Outlet: Integral.
- C. Flush Valves:
 - 1. Manufacturers:
 - a. Kohler
 - b. American Standard, Inc: www.americanstandard-us.com/#sle.
 - c. Sloan Valve Company: www.sloanvalve.com/#sle.

D. Urinal Carriers:

1. Manufacturers:

- a. Jay R. Smith MFG. Co: www.jrsmith.com/#sle.
- b. JOSAM Company: www.josam.com/#sle.
- c. Zurn Industries, Inc: www.zurn.com/#sle.

- 2. ASME A112.6.1M; steel frame, lugs for block wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.5 LAVATORIES

A. Manufacturers:

- 1. American Standard Inc: www.americanstandard.com.
- 2. Toto
- 3. Kohler Company: www.kohler.com/#sle.

- B. Vitreous China Counter Top Basin: ASME A112.19.2; vitreous china self-rimming counter top lavatory, with drillings on 4 inch centers, overflow, seal of putty, calking, or concealed vinyl gasket.

C. Supply Faucet Manufacturers:

- 1. Sloan Valve
- 2. American Standard, Inc: www.americanstandard-us.com
- 3. Delta
- 4. Kohler Company: www.kohler.com/.

- D. Supply Faucet: ASME A112.18.1; chrome plated supply fitting with open grid strainer, water economy aerator with maximum flow of 0.5 gpm, single lever handle.

E. Sensor Operated Faucet:

- 1. Spout Style: Standard.
- 2. Power Supply: Per manufacturer's requirements.
 - a. For 6V or 24V applications, provide plug in transformer.
- 3. Mixing Valve: None, single line for tempered water.

4. Water Supply: 3/8 inch compression connections.
 5. Aerator: Vandal resistant, 0.5 gpm, laminar flow device.
 6. Finish: Polished chrome.
- F. Thermostatic Mixing Valve:
1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.
- G. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
- H. For all accessible sinks, per Ansi A117.1, ADA, UFAS - provide offset drain tailpiece and insulate all exposed water and waste piping with premolded insulation.

2.6 ELECTRIC WATER COOLERS

- A. Manufacturers:
1. Elkay Manufacturing Company: www.elkay.com/#sle.
 2. Haws Corporation: www.hawesco.com/#sle.
 3. Oasis International: www.oasiscoolers.com/#sle.
 4. Halsey Taylor

2.7 BI-LEVEL, ELECTRIC WATER COOLERS

- A. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
 2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.8 MOP BASIN

- A. Manufacturers:

1. Acorn Engineering Company: www.americanstandard-us.com/#sle.
 2. Fiat Products
 3. Just Manufacturing Company: www.justmfg.com/#sle.
- B. Bowl:
1. 24 x 24 x 10 inch high white molded stone, floor mounted, with one inch wide shoulders, stainless steel strainer, stainless steel wall guards.
- C. Faucet:
1. ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available where required, and of the correct characteristics.
- C. Coordinate and confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Caulk and seal fixtures to wall and floor surfaces with sealant as specified in Section 079200, color to match fixture.

- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel or general public.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 224000 224000

SECTION 230500 - MECHANICAL GENERAL CONDITIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.
- B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein.
- C. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division.
- D. The following information contains specifications of Work in connection with, and in addition to, this Division:
 - 1. All drawings associated with the project.
 - 2. All specifications associated with the project.
- E. Division of work responsibilities shall be as defined and directed by the Bidding Agent and/or the Bidding General Contractor.

1.3 INTENT

- A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.
- B. Furnish, deliver and install any apparatus, appliance, material or Work not shown on Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories necessary to make the Work complete and perfect in all respects and ready for operation, even if not particularly specified, under their respective Section without additional expense to the Owner.
- C. Include in the work minor details not usually shown or specified but necessary for proper installation and operation, as though they were hereinafter shown or specified.

- D. Provide Engineer written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of Work omitted. In the absence of such written notice, it is mutually agreed that Work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.
- E. The Work indicated is diagrammatic. The Architect and/or Engineer may require as part of this Contract, the relocation of devices to reasonable distances from the general locations shown.
- F. Verbal clarifications of the Drawings or Specifications during the bid period are not to be relied upon. Refer any questions or clarifications to the Engineer at least five Working days prior to bidding to allow for issuance of an addendum. After the five-day deadline, Bidder must make a decision and qualify the Bid, if the Bidder feels it necessary.

1.4 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. (Do not scale the Drawings.) Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect.
- B. Closely follow Drawings in layout of Work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom. Where space conditions appear inadequate, Engineer shall be notified before proceeding with installations.
- C. Engineer may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.
- D. Where variances occur between the Drawings and Specifications or within either of the Documents, include the item or arrangement of better quality, greater quantity or higher cost in the Contract price. The Engineer shall decide on the item and the manner in which the work shall be installed.

1.5 SURVEYS AND MEASUREMENTS

- A. Before submitting a Bid, the Contractor shall visit the site and shall become thoroughly familiar with all conditions under which the work will be installed. Contractor will be held responsible for any assumptions, omissions or errors made as a result of failure to become familiar with the site and the Contract Documents.

- B. Base all measurements, both horizontal and vertical, from established bench marks. All Work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the Work.
- C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or the intent of the Drawings and Specifications, notify the Engineer do not proceed with that Work until instructions have been received from the Engineer.

1.6 CODES AND STANDARDS

- A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.
- B. The current adopted editions of the following State or local Codes apply:
 - 1. 2022 Connecticut State Building Code
 - 2. 2021 International Building Code
 - 3. 2021 International Mechanical Code
 - 4. 2021 International Plumbing Code
 - 5. 2020 National Electrical Code (NFPA 70)
 - 6. 2021 International Energy Conservation Code
 - 7. ICC/ANSI A117.1-2019 Accessible and Usable Buildings and Facilities
- C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.7 PERMITS AND FEES

- A. Give all necessary notices, obtain all permits; pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the Work. File all necessary

Drawings, prepare all Documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspections for Work and deliver a copy to the Engineer before request for acceptance and final payment for the Work.

1.8 SEISMIC RESTRAINT

- A. General: This project is in a seismic zone per State and/or Local Codes and Ordinances and all materials and equipment shall be installed, supported, and seismically restrained accordingly. Verify current seismic requirements based on project location and with Code requirements.
- B. Installation: Installation shall be carried out in strict accordance with the Seismic Engineer's submittal, current Code, accepted standards and the equipment and material manufacturers' recommendations.

1.9 COORDINATION

- A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.
- B. Contractors are required to examine all of the Project Drawings and mutually arrange Work so as to avoid interference.
- C. Where the Work of the Contractor will be installed in close proximity to or will interfere with Work of other trades, assist in working out space conditions to make a satisfactory adjustment.
- D. If Work is installed before coordinating with other Divisions or so as to cause interference with Work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.

1.10 ACCEPTANCES

- A. The equipment, materials, Workmanship, design and arrangement of all Work installed are subject to the review of the Engineer.
- B. Within 30 days after the awarding of a Contract, submit to the Engineer for review a list of manufacturers of equipment proposed for the Work. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

- C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, notify the Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.
- D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog or model number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.
- E. If material or equipment is installed before shop drawing review, liability for its removal and replacement is assumed by the Contractor, at no extra charge to the Owner, if, in the opinion of the Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.
- F. Failure on the part of the Engineer to reject shop drawings or to reject Work in progress shall not be interpreted as acceptance of Work not in conformance with the Drawings and/or Specifications. Correct Work not in conformance with the Drawings and/or Specifications whenever non-conformance is discovered.

1.11 EQUIPMENT DEVIATIONS

- A. Where the Contractor proposes to deviate (substitute or provide an equivalent) from the equipment or materials as hereinafter specified, he shall do so by making a request in writing. The Contractor shall state in his request whether it is a substitution or an equivalent to that specified, and the amount of credit involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified and scheduled with no exceptions. Equipment Manufacturers Scheduled on Drawings are considered Base Bid and any other acceptable manufacturers listed in the specifications is considered a substitution and equipment deviation and subject to the requirements for equipment substitution and deviation. When any alternate manufacturer does not qualify acceptable, as determined by the Engineer, provide the Base Bid manufacturer at no additional cost to Owner.
- B. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. In the event that only one (1) manufacturer of a product is specified and it is found that the

manufacturer has discontinued the product, the Contractor shall use an acceptable equivalent product that meets the requirements of an equivalent product, as noted below, and has all the features of the originally specified product. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate for those mentioned herein shall also conform to these standards.

- C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for the Engineer's review.
- D. Where two or more names are given as equivalents, the Contractor must use the specified item or one of the named equivalents. Where one name only is used and is followed by the words "or acceptable equivalent", the Contractor must use the item named or he may apply for an equipment deviation through the prescribed manner in accordance with this Specification.
- E. Equipment, material or devices submitted for review as an "accepted equivalent" shall meet the following requirements:
 - 1. The equivalent shall have the same construction features such as, but not limited to:
 - 2. Material thickness, gauge, weight, density, etc.
 - 3. Welded, riveted, bolted, etc., construction
 - 4. Finish, undercoatings, corrosion protection
 - 5. The equivalent shall perform with the same or better operating efficiency.
 - 6. The equivalent shall have equal or greater reserve capacity.
 - 7. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
 - 8. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.
- F. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

- G. Where such accepted deviation or substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.
- H. The Engineer shall determine if an "accepted equivalent" to a manufacturer listed in the Specifications is considered acceptable.

1.12 SHOP DRAWINGS

- A. Refer to individual specification sections for additional submittal information.
- B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed.
- C. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (9) copies for review.
- D. Provide shop drawings for all devices specified under equipment specifications for all systems, materials, equipment and/or devices. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal. Partial submissions shall be rejected.
- E. Equipment shop drawings shall contain full range performance curves, graphs, tables or other pertinent data which clearly indicates operational range of a given unit size. Computer generated/plotted curves, based solely on design performance, will not be accepted.
- F. All specific options and/or alternatives shall be clearly indicated. Failure to do so shall be grounds for rejection.
- G. Submittals shall be marked with the trade involved, i.e., HVAC, plumbing, fire protection, etc. and the specific associated specification section.

- H. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.
- I. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. Contractor must allow for a one week review at the Engineer's office plus normal delivery time to the G.C., Architect, Engineer, and return to the Architect, and G.C. No claim for extension by reason of such default will be allowed, nor shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer. The Contractor shall incur all costs associated with delay of construction due to equipment and/or materials arriving late due to late or improper shop drawing submittal.
- J. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.
- K. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not indicate that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.
- L. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.
- M. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.
- N. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.
- O. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer at least five (5) working days prior to Bidding to allow for issuance of an Addendum. After the five (5) day deadline, Bidder shall make a decision and qualify the Bid, if the Bidder deems if necessary.
- P. Contractor shall make any corrections required by Engineer and shall resubmit required number of corrected copies of shop drawings or new samples until accepted. Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than corrections requested by Engineer on previous submissions. Engineer shall review no more than

one resubmittal of any shop drawing or sample at Owner's expense. The fees for review of additional resubmittals shall be paid by the Contractor at the Engineer's standard rates.

1.13 CHANGES IN WORK

- A. A Change Order is a written order to the Contractor signed by the Owner and the Architect, issued after Contracts have been awarded, authorizing a change in the work or an adjustment in the Contract sum or the Contract time. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract sum or the Contract time.
- B. All changes in the work shall follow the recommendations of the AIA "General Conditions of the Contract for Construction", Article 12.

1.14 MANUFACTURER'S IDENTIFICATION

- A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate giving name of manufacturer, description, size, type, serial and model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. Nameplate data shall not be obstructed. The nameplate of a Contractor or distributor will not be acceptable.
- B. All material and equipment for the electrical portion of the mechanical systems shall bear the label of or be listed by UL, or other accredited authoritative agencies or testing organizations approved by the authority having jurisdiction.

1.15 RECORD DRAWINGS

- A. Maintain at the job site a record set of Mechanical Drawings on which any changes in location or routing of all equipment, materials and access panels shall be recorded.
- B. At the end of construction, the Contractor shall provide the Owner with a complete set of As-Built Drawings, including all updated coordination drawings, ductwork and piping plans. As-Builts shall be drawn on the latest version of Autocad or compatible software, approved in writing, prior to submittal. The Owner shall be provided with a "CD Rom" disk and one set of reproducible mylar sepias.

1.16 MATERIALS AND WORKMANSHIP

- A. All materials and apparatus required for the work, except as otherwise specifically indicated, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail and be so

selected and arranged as to fit properly into the building spaces. Where no specific type or quality of material is given, a first-class standard article as accepted by industry standards shall be furnished.

- B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.
- C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.
- D. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.17 PROTECTION OF MATERIALS AND EQUIPMENT

- A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.
- C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.18 BASES AND SUPPORTS

- A. Unless otherwise specifically noted, the Contractor shall furnish all necessary supports, rails, framing, bases and piers required for all equipment furnished under this Division.

1.19 SLEEVES, INSERTS AND ANCHOR BOLTS

- A. The Contractor shall provide, set in place and be held responsible for the location of all sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at the Contractor's expense.
- B. It is the responsibility of the Contractor to furnish cast-in-place steel sleeves, inserts and anchors in sufficient time to be installed during initial concrete pours. Where job schedules make this impossible, coordinate and obtain acceptance from the Structural Engineer for alternate installation methods.
- C. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an inside diameter one (1") inch larger than the outside diameter of the pipe, conduit or insulation enclosing the pipe.
- D. Piping insulation shall run continuous through sleeve.
- E. Penetrations through fire-rated walls, ceilings and all floors (except slab on grade) in which piping or ducts pass shall be filled solidly with acceptable fire-stopping material. Sleeves shall be steel or a UL / FM listed and approved assembly.

1.20 FIRE-STOPS AND SEALS

- A. Fire-stopping systems shall be submitted as shop drawing.
- B. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.
- C. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

1.21 CUTTING AND PATCHING

- A. All cutting and patching shall be done per Division 1 requirements. The Contractor shall furnish sketches showing the location and sizes of all openings, chases, etc., required for the installation of work.

- B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves required before the floors and walls are built or be responsible for cutting, drilling or chopping where sleeves and inserts were not installed or correctly located. The Contractor shall do all drilling required for the installation of hangers.
- C. Exercise extreme caution when core drilling or punching openings in concrete floor slabs in order to avoid cutting or damaging structural members. No structural members or structural slabs/floors shall be cut without the written acceptance of the Structural Engineer and all such cutting shall be done in a manner directed by him.

1.22 WATERPROOFING

- A. Where any work pierces waterproofing, including waterproof concrete and floors in wet areas, the method of installation shall be reviewed by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

1.23 ACCESSIBILITY AND ACCESS PANELS

- A. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, controllers, coil, valves, switchgear, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

1.24 TEMPORARY OPENINGS

- A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.25 SHUTDOWNS

- A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner's representative.
- B. The Engineer and the Owner shall be notified of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be

performed.

- C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

1.26 TAGS AND CHARTS

- A. Each valve and piece of apparatus under this Division shall be provided with suitable brass or laminated plastic tags securely fastened with brass chains, screws or rivets. Equipment shall be numbered with laminated plastic tags or neatly stenciled letters two (2") inches high using designations in equipment schedules and/or shall conform to a directory indicating number, location and use of each item. Directories shall be prepared under each Section and shall be glass framed.
- B. Directory shall indicate valve tag number and the unit number, floor/area branch line, main line, service or other pertinent data to quickly and easily identify the valve's purpose.

1.27 ESCUTCHEONS

- A. The Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions in finished visible locations.

1.28 PAINTING

- A. All finish painting in completed areas shall be performed per Division 9 of the Specifications.
- B. All materials shipped to the job site under this Division, such as grilles, registers and/or radiation covers, shall have standard manufacturer's finish, unless otherwise specified by Architect.
- C. The Contractor shall paint the interior of all ducts wherever the interior of the duct can be seen through a register or louver. Paint shall be flat black, rust preventative type.

1.29 PIPE EXPANSION

- A. All pipe connections shall be installed to allow for freedom of movement of the piping during expansion and contraction without springing.

1.30 ELECTRICAL CONNECTIONS

- A. Unless otherwise specified, all wiring shall be furnished and installed per Division 16 Specifications.

1.31 MAINTENANCE

- A. The Contractor shall provide the necessary skilled labor to assure the proper operation and to provide all required current and preventative maintenance for all equipment and controls provided under this Division until final acceptance of the building by the Owner. The Contractor shall not assume acceptance of the building by the Owner until he receives written notification.
- B. The Contractor shall receive calls for any and all problems experienced in the operation of the equipment provided under this Division and he shall take steps to immediately correct any deficiencies that may exist.
- C. The Contractor shall provide a check list and shall put a copy of it in the boiler or main mechanical room. The check list shall itemize each piece of equipment furnished under his Section.
- D. The Contractor shall certify on this check list that he has examined each piece of equipment and that, in his opinion, it is operating as intended by the manufacturer, it has been properly lubricated, and that all necessary current and preventative maintenance has been performed as recommended by the manufacturer and by good and accepted practice.
- E. The Contractor shall check all controls in the building to ascertain that they are functioning as designed. This shall apply to all thermostats, aquastats, humidistats, freezestats and firestats, etc. This portion of the work shall be performed by the Contractor who installed the controls.
- F. During construction, the Contractor shall ensure that all filters are in place on all equipment. If the equipment is operated during construction (see restrictions section of this specification), strict attention shall be paid to maintaining clean and effective filters and cleaning ductwork and equipment.
Filters shall be new and/or clean when the system testing and balancing takes place. The Contractor shall bear the cost of all filters and media during construction until final acceptance by the Owner. This requirement shall apply equally to fluid filters and strainers.
- G. Where normal preventative maintenance for any piece of equipment requires special tools, the Contractor shall furnish the appropriate tools for that piece of equipment (i.e., special filter removal hooks, valve wrenches, etc.).

1.32 DEMOLITION

- A. All required demolition work shall be performed by the Contractor. All demolition work shall be performed in a neat and orderly fashion.
- B. Demolition work, if indicated on the drawings, is intended for general information only and is not intended to describe the full extent of demolition

work required under this Contract. All existing mechanical work and systems, including but not limited to piping, equipment, ductwork, wiring, controls, hangers, and supports, made obsolete by this project, shall be removed in their entirety under this Contract, unless noted otherwise.

- C. After piping, ductwork, equipment, etc., has been removed, neatly cap remaining ductwork and piping, and insulate caps to match the existing adjacent ductwork and piping. In finished areas, all ductwork and piping shall be cut back to a concealed location, i.e., within walls, above ceilings, etc., before capping.
- D. Before submitting his Bid, the Contractor shall visit the site with the Contract Documents in hand, and shall inspect all existing systems to determine the extent of demolition work involved. Particular attention is drawn to the removal of existing walls or portions of existing walls. In those areas, all exposed and concealed piping, ductwork, equipment, etc., running across or through affected areas shall be removed as required. Piping and ductwork shall then be either capped, or, if required for the proper continuing operation of an existing system to remain, piping and ductwork shall be rerouted around the affected areas and reconnected as required.
- E. In general, it shall be the responsibility of the Contractor to remove demolished equipment, piping, ductwork, etc., from the site and properly dispose of it. If the Owner shall so request, however, the Contractor shall turn over demolished equipment, etc., to the Owner for the Owner's use. Unless otherwise noted, demolished work shall not be abandoned in place.
Contractor shall make safe all utilities pertaining to this section.

1.33 AIR ELIMINATION

- A. The Contractor shall be responsible for bleeding all air from closed hydronic piping systems after the system has been filled, and thereafter rebleeding as often as required to completely eliminate all air from the system.
- B. Where work on an existing piping system has allowed air to enter that system, the Contractor shall also bleed that system even if no piping work was done in the area where air has developed.
- C. Where air cannot be bled from any piping due to the absence of an air vent, the Contractor shall install a manual air vent in locations required to successfully bleed such air.
- D. Where the piping layout would require an air vent in an inaccessible location, the Contractor shall install an extended 1/4-inch copper bleed line and petcock to an accessible location such as a closet, mechanical room, above lay-in ceiling, etc.

1.34 LUBRICATION

- A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner. Units furnished with sealed bearings are exempted.

1.35 CLEANING

- A. The Contractor shall be responsible for keeping the jobsite clean, safe and neat throughout the duration of construction. The Contractor shall clean up his own debris daily and shall coordinate removal of rubbish and debris with the General Contractor/Construction Manager.
- B. Terminal equipment and plumbing fixtures shall be cleaned at substantial completion.
- C. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
- D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

1.36 OPERATING INSTRUCTIONS

- A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least 72 hours notice to the Owner and the Engineer in advance of this period.
- B. The appropriate Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

1.37 ADJUSTING AND TESTING

- A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment, the control operate as described in the sequence of operation and all systems are in satisfactory, permanent operating condition.
- B. Where requested by the Engineer, a factory-trained service engineering representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service engineering representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service engineering representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

1.38 GUARANTEES

- A. The Contractor shall guarantee all equipment, material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner, unless otherwise noted.
- B. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

PART 2 PRODUCTS - NOT USED.

PART 3 EXECUTION - NOT USED.

END OF SECTION 15010 230500

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.

1.3 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.4 SUBMITTALS

- A. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Wiles Architects and for inclusion in operating and maintenance manuals.
 - 2. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in I-P (inch-pound) units only.
6. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Engineer.
 - g. Project Contractor.
 - h. Project altitude.
 - i. Report date.

C. Project Record Documents: Record actual locations of balancing dampers.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 1. AABC MN-1, AABC National Standards for Total System Balance.
 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 4. SMACNA (TAB).

5. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 2. Having minimum of ten years documented experience.
 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- D. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Town of Trumbull.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

3.6 SCOPE

- A. Test, adjust, and balance the following:

- 1. Exhaust Fans
- 2. Energy Recovery Ventilator
- 3. Air Inlets and Outlets

3.7 MINIMUM DATA TO BE REPORTED

- A. Report:

- 1. Summary Comments:
 - a. Design versus final performance
 - b. summary of outdoor and exhaust flows to indicate amount of building pressurization
 - c. Nomenclature used throughout report
 - d. Test Conditions
- 2. Instrument List:
 - a. Manufacturer
 - b. Model number
 - c. Serial number
 - d. Range
 - e. Calibration date

- B. Air Moving Equipment: (ERV)

- 1. Location
- 2. Manufacturer
- 3. Model number
- 4. Air flow, specified and actual
- 5. Return air flow, specified and actual

6. Outside air flow, specified and actual
- C. Exhaust Fans:
 1. Location
 2. Manufacturer
 3. Model number
 4. Air flow, specified and actual
 5. Total static pressure (total external), specified and actual
- D. Air Distribution Tests:
 1. Air terminal number
 2. Room number/location
 3. Terminal type
 4. Terminal size
 5. Area factor
 6. Design velocity
 7. Design air flow
 8. Test (final) velocity
 9. Test (final) air flow
 10. Percent of design air flow

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 SECTION INCLUDES

- A. Duct insulation.
- B. Insulation jackets.

1.3 RELATED REQUIREMENTS

- A. Section 233100 - HVAC Ducts and Casings: Metal and non-metal ducts.

1.4 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.
- E. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, UL 723, ASTM E 84, NFPA 255, UL 723, ASTM E 84, NFPA 255, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:

1. Knauf Insulation: www.knaufusa.com.
 2. Johns Manville Corporation: www.jm.com/#sle.
 3. Owens Corning Corp: www.owenscorning.com/#sle.
 4. CertainTeed Corporation;: www.certainteed.com.
 5. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C 553; flexible, formaldehyde-free, noncombustible blanket, Greenguard Certified.
1. 'K' value: 0.27 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum Water Vapor Sorption: 5.0 percent by weight.
 3. Density: 0.75 lb/cuft.
 4. Equal to Johns Manville Microlite XG.
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.029 ng/Pa s m (0.02 perm inch), when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Tie Wire: Annealed steel, 16 gage.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

- C. Insulated ducts conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ducts conveying air above ambient temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces less than 10'-0" Above Finished Floor shall be 2" rigid fiber board.
- F. External Duct Insulation Application:
 - 1. Refer to detail on drawings.

3.3 DUCT INSULATION SCHEDULE

- A. Outside Air Intake and Exhaust Ducts: in attic 3" (minimum installed *-8)
- B. Supply Ducts Above Suspended Ceilings: 2" (minimum installed R-5)
- C. Exposed Ducts Within Space Served: 0"
- D. Exhaust Ducts in Attic : 1-1/2"
- E. All other Exhaust Ducts: 0"
- F. Supply and Return ducts in attic: 3" (minimum installed R-8)

END OF SECTION 23 07 13 230713

SECTION 230923 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. The Enterprise wide network will be provided by the owner and supports the Internet Protocol (IP). Local connections of the Building Controller shall be on ISO 8802-3 (Ethernet). Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using LonTalk FTT-10 and LonMark profiles and/or use BACnet MSTP as prescribed by the BACnet standard to perform communications to a network of Custom Application and Application Specific Controllers. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using LonTalk FTT-10 and LonMark profiles and/or use BACnet MSTP as prescribed by the BACnet standard. Proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program Programmable specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system along with scheduling, and trending applications will be left with the owner. All software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner.

1.2 APPROVED MANUFACTURERS

- A. Basis of Design: Alerton – BACTalk
- B. Siemens -Apogee
- C. Schneider Electric - EcoStruxure

1.3 QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned and serviced by factory trained personnel. Manufacturer shall have an in-place support facility within 1 hours response time of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.
- B. The Bidder shall be regularly engaged in the installation and maintenance of BAS systems and shall have demonstrated technical expertise and experience in the manufacture, installation and maintenance of BAS systems similar in size and complexity to this project.
- C. The BAS system manufacturer must have a Dealer or Customer Support call-in Center located at the corporate headquarters or corporate manufacturing facilities. The Customer Support call-in Center will be staffed by fully trained and certified technicians.
- D. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- E. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- F. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- G. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 50 miles of project site.

1.4 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2001, BACnet.
 - 3. ANSI/EIA/CEA-709.1 (LonTalk)
 - 4. ANSI MC85.1 - Terminology for Automatic Control
 - 5. Uniform Building Code (UBC), including local amendments.

6. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 7. National Electrical Code (NEC).
 8. FCC Part 15, Subpart J, Class A
 9. EMC Directive 89/336/EEC (European CE Mark)
 10. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.5 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours Monday through Friday, 48 hours on Saturday and Sunday.
- C. This warranty shall apply equally to both hardware and software.

PART 1 PRODUCTS

2.1 WEB INTERFACE

- A. General
1. BAS supplier shall provide web-based access to the system as part of standard installation. User shall be able to access all displays of real-time data that are part of the BAS via a standard Web browser. Web browser shall tie into the network via owner-supplied Ethernet network connection. Web-page host shall be a separate device that resides on the BAS BACnet network, but is not the BAS server for the control system. BAS server must be a separate computer from the Web-page host device to ensure data and system integrity. The web-page software shall not require a per user licensing fee or annual fees. The web-page host must be able to support on average 50 simultaneous users with the

ability to expand the system to accommodate an unlimited number of users.

B. Browser Technology

1. Browser shall be standard version of Microsoft IE 5.5 or later or Netscape Navigator 4.76 or later. No special vendor-supplied software shall be needed on computers running browser. All displays shall be viewable and the Web-page host shall directly access real-time data from the BAS BACnet network. Data shall be displayed in real time and update automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate user name and password.

C. Communications

1. Web-page host shall include two Ethernet network connections. One network connection shall be dedicated to BAS BACnet network and shall be used to gather real-time data from all the BACnet devices that form the BAS. This network shall communicate via BACnet, allowing the Web-page host to gather data directly from units on the local LAN or from other projects connected over a WAN. This network shall also provide the connection to the BAS server for Web page generation.
2. The second Ethernet connection shall provide the physical connection to the Internet or an IP-based WAN. It shall be the port that is used for the browser to receive Web pages and data from the Web-page host.. The Web-page host shall act as a physical barrier between the BAS network and the WAN or Internet connection that allows the browser to receive web pages and data. The two separate network connections provide for a physical barrier to prevent raw BACnet traffic being exposed on the IP network.
3. The Web-page host shall provide for complete isolation of the IP and BACnet networks by not routing networking packets between the two networks.
4. BAS BACnet Ethernet network shall be provided and installed by the BAS supplier. Owner shall provide and incur any monthly charges of WAN/Internet connection.

D. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.

E. Operator Activity Log

1. Operator Activity Log shall be included with system that tracks all operator changes and activities. System shall track what is changed in the system, who performed this change, date and time of system activity and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation.
2. Log shall be gathered and archived to hard drive on operator workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. Any displayed data, that is changeable by the operator, may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

F. Scheduling

1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.

G. Alarm Indication and Handling.

1. Operator's workstation shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s), currently running. Printout of alarms shall be sent to the assigned terminal and port.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the operator's terminal or via remote communication.
4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting alarm setup.

H. Trendlog Information

1. System server shall periodically gather historically recorded data stored in the building controllers and archive the information. Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's workstation. Operator shall be able to scroll through all trended data. All trendlog information shall be displayed in standard engineering units.
2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x,y) graphs that display up to ten object types at the same time in different colors. Graphs shall show object values relative to time.
3. Operator shall be able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.

4. System shall include a trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.

I. Field Engineering Tools – Engineering Tools Must Be Submitted on.

1. Building controller shall include field-engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to pick graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a real time operation mode. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
5. Field engineering tool shall include Device Manager for automatic detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number and description of connected devices. It shall record and display software file loaded into each controller. If needed, this file shall be downloaded to the appropriate controller by selection using the mouse.
6. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media.

2.2 BUILDING CONTROLLER

A. General Requirements

- B. Building Controller shall consist of a power supply, BACnet Ethernet-MS/TP, BACnet MS/TP, LonTalk FTT-10, and modem module for telephone communication as a minimum. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers including central plant controllers, advanced Programmable controllers and unitary controllers supplied by BMS manufacturer shall utilize the LonTalk or BACnet protocol standards.
- C. All communication with operator workstation shall be via BACnet Ethernet. All communication with Programmable controllers shall be LonTalk FTT-10 or BACnet MS/TP. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and MS/TP, FTT-10 LANS. Ethernet – MS/TP, FFT module shall also route messages from all other Building Controller modules onto the BACnet Ethernet network.
 - 1. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
 - 2. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
- D. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).
- E. Building Controller MS/TP module communications shall be via BACnet master slave token passing (MS/TP) LAN. Building Controller FTT-10 module communications shall be via LONtalk FTT-10 LAN using transceivers to all advanced Programmable and Programmable specific controllers. MS/TP module shall also route messages to Ethernet-MS/TP module for communication over WAN.
 - 1. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps
 - 2. Configuration shall be via RS-232 connection.
- F. All controllers shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by a building controller. The software program implementing these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, via a wide area network or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.

- G. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller.
- H. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing.
- I. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery back up shall maintain real-time clock functions for a minimum of 20 days.
- J. Global control algorithms and automated control functions shall execute via 32-bit processor.
- K. Automatic Time Scheduling:
 - 1. Self-contained programs for automatic start/stop/scheduling of building loads.
 - 2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
 - 3. Special day's schedule supporting up to 30 unique date/duration combinations.
 - 4. Number of loads assigned to time program; with each load having individual time program.
 - 5. Each load assigned at least 16 control actions for each day with 1 minute resolution.
 - 6. Furnish the following time schedule operations:
 - a. Start.
 - b. Optimized Start.
 - c. Optimized Stop.
 - d. Cycle.
 - e. Optimized Cycle.
 - 7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.
 - 8. Create temporary schedules.
 - 9. Broadcast temporary "special day" date and duration.

- L. Start/Stop Time Optimization:
 - 1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
 - 2. Adaptive and self-tuning, adjusting to changing conditions unattended.
 - 3. For each point under control, establish and modify:
 - a. Occupancy period.
 - b. Desired temperature at beginning of occupancy period.
 - c. Desired temperature at end of occupancy period.
- M. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
- N. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.
 - 1. Employ arithmetic, algebraic, Boolean, and special function operations.
 - 2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.
- O. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.
 - 1. Define time interval between each control action between 0 to 3600 seconds.
 - 2. Output may be analog value.
 - 3. Provide for "skip" logic.
 - 4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.
- P. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.
 - 1. Control loops: Defined using "modules" are analogous to standard control devices.
 - 2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.

3. Firmware:
 - a. PID with analog or pulse-width modulation output.
 - b. Floating control with pulse-width modulated outputs.
 - c. Two-position control.
 - d. Primary and secondary reset schedule selector.
 - e. Hi/Low signal selector.
 - f. Single pole double-throw relay.
 - g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
 4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.
 5. Display: Value or state of each of lines interconnecting DDC modules.
- Q. Fine Tuning Direct Digital Control PID or floating loops:
1. Display information:
 - a. Control loop being tuned.
 - b. Input (process) variable.
 - c. Output (control) variable.
 - d. Set-point of loop.
 - e. Proportional band.
 - f. Integral (reset) Interval.
 - g. Derivative (rate) Interval.
 2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".
- R. Trend logging:
1. Each control unit capable of storing samples of control unit's data points.
 2. Update file continuously at operator assigned intervals.
 3. Automatically initiate upload requests and then stores data on hard disk.

4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
5. Co-ordinate sampling with specified on/off point- state.
6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

S. Modem Module

1. Provide all functions that will allow remote communications via modem module to off-site locations. Modem module shall integrate directly into modular controller without any special software or hardware. Include one modem module along with all cabling necessary for installation for the system.
2. Provide Windows 2000 software for off-site computer that allows operator to view and change all information associated with system on color graphic displays. Operator shall be able to change all parameters in this section from off-site location including all programming of building controllers and all Programmable controllers including all terminal unit controllers.
3. Building controller shall have capability to call out alarm conditions automatically. If desired, controller may also send encoded message to digital pager. If an alphanumeric pager is in use by the operator, building controller shall be capable of sending a text or numeric string of alarm description. All building controllers connected to the local LAN shall be capable of calling out alarm messages through one or more shared modems connected to one or more of the building controllers on the local LAN.
4. Building controller shall have capability to call a minimum of 20 different phone numbers. Numbers called may be controlled by type of alarm or time schedule.
5. Owner shall provide standard voice-grade phone line for remote communication function.
6. Building controller and internal modem shall be capable of modem-to-modem baud rates of 33.6 Kbps minimum over standard voice-grade phone lines. Lower baud rates shall be selectable for areas where local phone company conditions require them.

2.3 TERMINAL UNIT PROGRAMMABLE CONTROLLERS (HEAT PUMPS, AC UNITS, FAN COILS)

- A. Provide one controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet or FTT-10 using LonTalk protocols. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
- B. Communication Conformance
 - 1. Programmable controllers shall communicate using LonTalk or BACnet MSTP, ANSI/ASHRAE Standard 135-2004 (BACnet). Controllers communicating using LonTalk shall use FTT-10 transceivers and communicate using LonMark-approved SNVTs
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet or LonMark object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Programmable controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, 4–20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of Programmable controller shall be completely modifiable in the field over installed BACnet and LonTalk LANs or remotely via modem interface.

Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen.

- E. Programmable controller shall include support for intelligent room sensor. Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.4 VAV BOX CONTROLLERS—SINGLE DUCT

- A. Provide one controller for each VAV box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet or FF-10 using LonTalk protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. Programmable controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Programmable controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).
- C. All program sequences shall be stored on board Programmable controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of Programmable controller shall be completely modifiable in the field over installed BACnet or LonTalk LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Programmable controller shall be programmed using the same programming tool as Building Controller and as described in operator workstation section. All programming tools shall be provided as part of system.
- D. Programmable controller shall include support for intelligent room sensor. Display on room sensor shall be programmable at Programmable controller and include an operating mode and a field service mode. All button functions

and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.

- E. On board flow sensor shall be microprocessor driven and precalibrated at the factory. Precalibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.

2.5 SENSORS AND MISCELLANEOUS DEVICES

A. Temperature Sensors

- 1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches about finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

B. Field Service Tool

- 1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in Programmable controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
- 2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.

C. Network Connection Tool

- 1. Network connection tool shall allow technician to connect a laptop to any MS/TP or FFT-10 network or device and view and modify all information throughout the entire network. Laptop connection to tool shall be via Ethernet or PTP.

2. Provide quick connect to MS/TP or FFT-10 LAN at each controller. Tool shall be able to adjust to all MS/TP and FFT-10 baud rates specified in the BACnet and LonMark standards.
3. Proved XX Network Connection Tools for this project.

2.6 ELECTRONIC ACTUATORS

A. Quality Assurance for Actuators

1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
3. Five-year manufacturers warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators

1. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.
2. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).

C. Actuators for Damper shall be Electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify Actuators.
2. NEMA 2 rated actuator enclosures are. Use additional weather shield to protect actuator when mounted outside.
3. 5 year Manufacturers Warranty. Two-year unconditional + Three year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.

6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
7. A push button gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24Vac and consume 10VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
3. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)
6. Performance Verification Test
 - a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate which is stable and responsive. Actuator movement shall not occur before the

effects of previous movement have affected the sensor.

- b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.

7. Actuator Mounting for Damper arrangements shall comply to the following:

- a. Damper Actuators: Shall not be installed in the air stream
- b. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
- c. Damper actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
- d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
- e. Damper mounting arrangements shall comply to the following:
 - 1) The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.

E. All controllers, power supplies and relays shall be mounted in enclosures.

F. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.

G. Enclosures shall have hinged, locking doors.

H. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.

PART 1 EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

- B. Notify the owners' representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units where not subject to excessive vibration. Obtain approval on locations from owner's representative prior to installation.
- B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operations.
- C. Install with 120 volt alternating current, 15 amp dedicated circuit to each programmable control unit or local UPS provided by ATC.
- D. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- E. Identify all equipment and panels. Provide permanently mounted tags for all panels.

3.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required prior to rough-in.

- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).

3.5 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of 3 persons.
- C. Provide on-site training above as required, up to 8 hours as part of this contract.
- D. Provide tuition for at least one individual for a one-week factory training class. If applicable, costs for travel, lodging and meals will be the responsibility of the Owner.

PART 1 SEQUENCE OF OPERATIONS

4.1 GENERAL

- A. Setpoints and values listed in the sequence of controls shall be adjustable by the Owner thru the Building Automation System (BAS). The Building Automation System (BAS) or direct digital controls (DDC) or Building Management System (BMS) are used interchangeably and share the same meaning.
- B. Other than utility rooms and corridors, space temperature sensor shall be capable of placing the associated systems into the occupied mode for a period of two hours (adj.).

4.2 ERV SEQUENCE OF OPERATIONS

- A. Enabling: ERV will be enabled by the building automation system (BAS). BAS shall read alarms and read sensor inputs made available by the ERV

factory furnished BACnet controller. BAS shall write discharge air temperature setpoints to ERV factory furnished BACnet controller. ERV factory controller shall command the sequence of operations if any of the following devices are not activated.

1. Internal safety devices.
 2. Smoke Detector.
 3. High static pressure.
- B. Damper Actuator Control:
1. Outside air and exhaust fan dampers shall be fully open.
- C. ERV Fan Control.
1. Supply fan VFD shall modulate the supply fan as required to maintain ductwork static pressure. Exhaust fan VFD to track supply fan.
- D. Discharge air temperature control:
1. When discharge air temperature set point decreases below setpoint, controller shall modulate electric duct heater as required to maintain discharge air temperature setpoint.

4.3 FANS

- A. Enabling: building automation system (BAS) shall enable and command the sequence of operations for the following fans.
1. BMS shall index fan to either unoccupied or occupied mode:
 2. Unoccupied mode:
 - a. Damper shall be fully closed where motorize damper is indicated.
 - b. Fan shall be off.
 3. Occupied mode:
 - a. Damper shall be fully opened.
 - b. If damper position does not match command, fan shall not operate and alarm issued to operator work station.

4.4 VAV – DEMAND CONTROL VENTILATION

- A. Enabling: VAV will be controlled by the building automation system (BAS). BAS unit controller to operate in occupied mode or unoccupied mode.

- B. Unoccupied mode:
 - 1. In unoccupied mode, CO2 control damper shall be fully closed.
- C. Occupied mode:
 - 1. VAV damper actuator shall modulate as required to maintain the space CO2 setpoint 400 ppm higher than the outdoor CO2 level.

4.5 VRF SEQUENCE OF OPERATIONS

- A. Enabling: VRF will be enabled by the building automation system (BAS). BAS shall read alarms and read sensor inputs made available by the VRF furnished BACnet controller. BAS shall write discharge air temperature setpoints to VRF furnished BACnet controller. VRF controller shall command the sequence of operations.
- B. The Automatic Temperature Controls (ATC) contractor shall also be responsible for installation and communication wiring of all VRF control components to provide a complete and operational system including but not limited to room controller, heat recovery boxes, and outdoor units. The VRF manufacturer will furnish (1) wall controller per indoor unit and associated cabling.
- C. Heating and cooling mode shall be enabled on demand to maintain space temperature setpoint. VRF internal factory control shall manage the following components.
 - a. Modulate evaporator fans speed, compressors, refrigerant metering valves and condenser fans as required to maintain temperature after the DX coil.

4.6 ALARMS:

- A. ERV Alarm.
 - 1. BAS controller shall monitor ERV factory furnished internal safety alarms. Alarm shall be issued to BAS Operator Work Station if any internal safety or high static alarms are activated.
 - 2. ERV control system shall temperature setpoints. Alarm shall be issued to BAS if any temperature setpoint does not match setpoint.
- B. Exhaust Fan Alarms.
 - 1. BAS controller shall monitor damper position. If damper position does not match the command, an alarm shall be generated at the BAS and the associated fan shall be commanded to stop.

2. BAS controller shall monitor fan status. If fan status does not match the command, alarm shall be generated at BMS.

C. VAV – Demand Control Ventilation Alarms

1. BAS shall monitor space CO2 Level. If CO2 level does not match setpoint for a predetermined time period, an alarm shall be generated at BMS.

D. VRF Alarm.

1. BAS shall monitor VRF control system internal safety alarms via BACnet interface. Alarm shall be issued to BAS if any internal safety alarms are activated.
2. VRF control system shall monitor space temperature. Alarm shall be issued to BAS if any space temperature does not match setpoint.
3. BAS shall monitor condensate auxiliary drain pan water detection. If sensor is activated, alarm shall be generated at the BAS
4. BAS shall monitor space temperature status. If space temperature does not match setpoint for a predetermined time period, an alarm shall be generated at BMS.

END OF SECTION 230923

SECTION 232300 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Piping.

1.3 RELATED REQUIREMENTS

- A. Section 23 81 28 - Variable Refrigerant Flow Zoning System.

1.4 REFERENCE STANDARDS

- A. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- B. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2013.
- C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.
- D. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.
- E. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- F. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.5 SYSTEM DESCRIPTION

- A. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

1.6 SUBMITTALS

- A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

- C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- E. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum ten years of documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 PRODUCTS

2.1 PIPING

- A. Drawn (rigid) Copper Tube: Type ACR, R410 rated, ASTM B280, H58 temper, clean, dry and capped.
 - 1. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Annealed (soft) Copper Tube: Type ACR, R410 rated, ASTM B280, O60 temper, clean, dry and capped .
 - 1. Joints: Flare or Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
 - 2. **Use of soft copper tube shall be limited to runout piping (of nominal pipe sizes of 1/2" or less) from BC controller to fan coils.**
- C. Pipe Supports and Anchors:
 - 1. Conform to ASME B31.5.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.2 REFRIGERANT

- A. Refrigerant: R410a, as defined in ASHRAE Std 34.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove scale and dirt on inside and outside before assembly.

3.2 INSTALLATION

- A. Install refrigeration piping in accordance with VRF system manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping free of traps, sags, tee fittings, sight glasses, filter dryers, solenoid valves and other after-market accessories.
- D. Install piping to conserve building space and avoid interference with use of space.
- E. Group piping whenever practical at common elevations and locations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Flood piping system with nitrogen when brazing.
- I. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

3.3 FIELD QUALITY CONTROL

- A. Pressure test system with dry nitrogen. Test to zero leakage. Evacuate and fully charge system after testing.

3.4 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch or less, 5/8 inch, and 7/8 inch : Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.

END OF SECTION 23 23 00 232300

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork.

1.2 RELATED REQUIREMENTS

- A. Section 230713 - Duct Insulation: External insulation and duct liner.
- B. Section 233300 - Air Duct Accessories.
- C. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.4 SUBMITTALS

- A. Product Data: Provide data for duct materials.
- B. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum ten years of documented experience.

PART 2 PRODUCTS

2.1 DUCT ASSEMBLIES

- A. Low Pressure Supply: 2 inch w.g. pressure class, Class C seal, galvanized steel.
- B. Return and Relief: 2 inch w.g. pressure class, Class C seal, galvanized steel.
- C. General Exhaust: 1/2 inch w.g. pressure class, Class C seal, galvanized steel.

2.2 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
- C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners.

2.3 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

- D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes.
- E. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.
- B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use double nuts and lock washers on threaded rod supports.
- G. Connect diffusers to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

END OF SECTION 233100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Flexible duct connections.
- C. Volume control dampers.

1.3 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.4 SUBMITTALS

- A. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Krueger: www.krueger-hvac.com/#sle.
 - 2. Ruskin Company: www.ruskin.com/#sle.

3. Titus: www.titus-hvac.com/#sle.

4. Substitutions: See Section 016000 - Product Requirements.

- B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.2 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.3 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

2.4 VOLUME CONTROL DAMPERS

- A. Manufacturers:

1. Greenheck, Inc: www.greenheck.com

2. Nailor Industries Inc: www.nailor.com/#sle.

3. Ruskin Company: www.ruskin.com/#sle.

4. Substitutions: See Section 016000 - Product Requirements.

- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

- C. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .

- D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

- E. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Provide duct test holes where indicated and required for testing and balancing purposes.
- B. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- C. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 220548.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- E. Use splitter dampers only where indicated.
- F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Ceiling exhaust fans.
- B. Inline centrifugal fans.
- C. Kitchen hood through wall exhausters.

1.3 RELATED REQUIREMENTS

- A. Section 230513 - Common Motor Requirements for HVAC Equipment.
- B. Section 233300 - Air Duct Accessories: Backdraft dampers.
- C. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.4 SUBMITTALS

- A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- B. Manufacturer's Instructions: Indicate installation instructions.
- C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Loren Cook Company; _____: www.lorencook.com/#sle.
- B. CaptiveAire
- C. Substitutions: See Section 230500, Mechanical General Conditions, Para 1.11 Equipment Deviations

2.2 POWER VENTILATORS - GENERAL

- A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.3 CEILING EXHAUST FANS

- A. Manufacturers:
 - 1. Loren Cook.
 - 2. Greenheck Fan Corporation.
 - 3. Panasonic Corporation of North America.
- B. Performance Ratings:
 - 1. Refer to the schedule on the plans for fan performance and all required accessories and options.
- C. Centrifugal Fan Unit: Energy Star rated, direct driven with galvanized steel housing , resilient mounted DC motor, gravity backdraft damper in discharge.
- D. Grille: Molded white plastic.

2.4 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
 - 1. Greenheck Fan Corporation; _____: www.greenheck.com/#sle.

2. Loren Cook Company; _____: www.lorencook.com/#sle.

B. Performance Ratings:

1. Refer to Schedule on plans for fan performance ratings and all accessories and options

C. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing, resilient mounted motor, gravity backdraft damper in discharge.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.5 KITCHEN HOOD WALL EXHAUSTER

A. Manufacturers:

1. Captiveaire Model DU-HFA.

B. Performance Ratings:

1. Refer to Schedule on Drawings for fan characteristics and all accessories and options

C. Belt Drive Fan:

1. Fan Wheel:

a. Type: Non-overloading, backward inclined centrifugal.

2. Statically and dynamically balanced.

3. Motors:

a. Open drip-proof (ODP).

b. Mount on vibration isolators or resilient cradle mounts, out of air stream.

c. Fully accessible for maintenance.

4. Housing:

a. Constructed of heavy gage aluminum or G90 galvanized, including curb cap, windband, and motor compartment.

b. Rigid internal support structure.

- c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
 - d. Drive frame assembly of heavy gage steel, mounted on vibration isolators.
 - e. Provide breather tube for fresh air motor cooling and wiring.
- D. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - 2. Bearings:
- E. Disconnect Switch:
 - 1. Factory mounted and wired.
 - 2. Environment Type per NEMA 250:
 - a. Outdoor Locations: Type 3R.
- F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- G. Options/Accessories:
 - 1. Drain Connection:
 - 2. Grease Trap:
 - 3. Hinge Kit:
 - a. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Hung In Line Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads.
 - 2. Install flexible connections specified in Section 233300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

- C. Provide backdraft dampers on outlet from in-line and ceiling exhaust fans and as indicated.

END OF SECTION 233423

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.3 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2001.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.4 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

PART 3 EXECUTION

2.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install diffusers to ductwork with air tight connection.
- C. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- D. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION 233700

SECTION 237213 - AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Packaged air-to-air energy recovery units.

1.3 RELATED SECTIONS

- A. Section 230548 - Vibration and Seismic Controls for HVAC Systems.
- B. Section 230593 - Testing, Adjusting and Balancing for HVAC
- C. Section 230993 - HVAC Sequence of Operations.
- D. Section 238216 - Air Coils.
- E. Section 233100 - HVAC Ducts and Casings.
- F. Section 233300 - Air Duct Accessories: Flexible duct connections.
- G. Section 262717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.4 REFERENCES

- A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2003.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 1999 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- C. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc.; 2005.
- D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 2005.
- E. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2003.

- F. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.
- G. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.
- H. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.; 2004.

1.5 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data:
 - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
 - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
 - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
 - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- D. Manufacturer's Instructions: Include installation instructions.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 EXTRA MATERIALS

- A. See Division 01 - General Requirements, for additional provisions.
- B. Supply one set for each unit of fan belts.
- C. Provide four sets of filters for each unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Indoor Energy Recovery Unit:
 - 1. Gfreenheck
- B. Substitutions: See Section 230500 Mechanical General Conditions, Para 1.11 Equipment Deviations.

2.2 CABINET

- A. Materials: Formed single wal insulated metal cabinet, fabricated to permit access to internal components for maintenance..
- B. Outside Casing: 20 gauge, galvanized (G90) steel meeting ASTM A653.
- C. Access doors shall be hinged with airtight closed cell foam gaskets. Door pressur taps, with captive plugs, shall be provided for cross-core pressure measurement.
- D. Insulate unit walls and doors with 1" thick, 4 - pound density, foil/scrim face, high density fiberglass board insulation, with a minimum R value of 4.3.
- E. Energy recovery core shall be of the total enthalpy typ, etransfering both sensible and latent heat between air streams Latent energy tranfer shall be accomplished by direct water vapor transfer from one air stream to the other. The core shall be designed and constructed to permit cleaning and removal for servicing. The core shall have a 10 year warranty. Performance criteria per AHRI Standard1060

- F. Passive frost control: The core shall perform without frosting under normal operating conditions (outside temperature above -10F and inside relative humidity below 40%). No condensate drains will be allowed..

2.3 COMPONENTS

A. Air stream components

1. Blower Section

- a. Blower section construction, supply and exhaust: Blower assemblies consist of a 208V, 3 phase, 60 HZ TEFC motor and a belt driven forward curved blower.
- b. Blower assemblies shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

2. Filter Section

- a. Provide 2 inch, MERV 13 disposable pleated filters in outside and exhaust air streams, accessible from the outside of the unit.

3. Outlet

- a. Provide a sleeve on the exterior perimeter of the outlet for connection of duct work.

2.4 ELECTRICAL

- A. Units shall be factory wired with a single point power connection.
- B. Units shall be wired according to NEC and listed per ETL.
- C. ETL listing shall cover all components of the ventilator and not be limited to the control panel.
- D. All major electrical components shall be UL listed.
- E. Unit shall be constructed with an integral control center isolated from supply airflow and exhaust airflow.
- F. The following items shall be provided and wired within the control center by the factory:
 - 1. Non-fused disconnect.
 - 2. Sub-circuit fusing.
 - 3. Low voltage transformers.

4. Control circuit fusing.
5. Terminal block.
6. Fan motor variable frequency drives.
7. BacNet interface card

2.5 FACTORY VERIFICATION TESTING

- A. Unit shall be run tested prior to shipment from the factory.
- B. Factory run test report shall be provided at the request of the engineer, contractor, or owner.
- C. Testing Procedures
 1. Unit shall be subjected to and pass a dielectric (hipot) test.
 2. All motorized dampers shall be cycled one full stroke while installed in the unit using the factory-provided motorized actuators.
 3. Supply fan
 - a. Visually inspect ramp-up, ramp-down, and rotation direction of fan when enabled.
 - b. Verify fan pressure proving switch operation.
 - c. Measure and record current draw through supply fan motor(s).
 4. Exhaust fan
 - a. Visually inspect ramp-up, ramp-down, and rotation direction of fan when enabled.
 - b. Verify fan pressure proving switch operation.
 - c. Measure and record current draw through supply fan motor(s).
 5. Test report shall be included with unit and available from the factory upon request.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Bolt sections together with gaskets.

- C. Isolate fan sections with flexible duct connections.
- D. Install flexible duct connections between fan inlet and exhaust and supply ductwork. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Install assembled unit on vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as indicated. Refer to Section 15072. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

3.2 EQUIPMENT START-UP

- A. Provide the services of a factory trained technician for start-up of all energy recovery system components. Provide assistance to Balancing Contractor and Commissioning Agent as required in order to insure proper start-up balancing and commissioning of equipment.

END OF SECTION 237213

SECTION 238101 - TERMINAL HEAT TRANSFER UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Electric unit heaters.
- B. Electric cabinet unit heaters.

1.3 RELATED REQUIREMENTS

- A. Section 230593 - Testing, Adjusting, and Balancing.
- B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.4 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
 - 2. Indicate mechanical and electrical service locations and requirements.,
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 EXTRA MATERIALS

- A. See Division 01 - General Requirements, for additional provisions.
- B. Provide four sets of filters for each cabinet unit heater.

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS AND CABINET UNIT HEATERS

- A. Manufacturers:
 - 1. QMARK
 - 2. BERCO
 - 3. Brasch:
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Assembly: UL listed and labelled assembly with terminal box and cover, and built-in controls.
- C. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.
- D. Cabinet: 0.0478 inch steel with easily removed front panel with integral air outlet and inlet grilles.
- E. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.
- G. Motor: Permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models.
- H. Control: Built-in thermostat, thermal cutout and automatic fan delay control.
- I. Electrical Characteristics: Refer to the schedule on the plans.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Protection: Provide finished cabinet units with protective covers during balance of construction.
- C. Unit Heaters: Hang from building structure, with pipe hangers anchored to building. Mount as high as possible to maintain greatest headroom.
- D. Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.
- E. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Section 260583.

3.2 CLEANING

- A. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- B. Install new filters.

END OF SECTION 238101

SECTION 238128 - VARIABLE REFRIGERANT FLOW ZONING SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Air-source heat pumps.
- B. Indoor ductless units.
- C. Indoor ducted units
- D. Controls.

1.3 RELATED REQUIREMENTS

- A. Section 23 05 93 - Testing, Adjusting , and Balancing for HVAC.
- B. Section 23 23 00 - Refrigerant Piping.

1.4 REFERENCE STANDARDS

- A. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2004.
- B. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems; National Fire Protection Association; 2002.
- C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2006.

1.5 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- C. Design Data: Indicate refrigerant pipe sizing.
- D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

- E. Project Record Documents: Record actual locations of components and connections.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Town of Trumbull's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience.
- B. Units shall be tested by a nationally recognized testing laboratory and bear the ETL Label.
- C. Units shall be manufactured in a factory that is ISO 9001 and ISO 14001 registered.
- D. The VRFZ system shall be installed by a contractor with extensive installation and service training. The contractor shall show proof of completion of mandatory service and installation training by the manufacturer.

1.7 WARRANTY

- A. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from the date of installation. In addition the compressor shall have a limited warranty for a period of seven (7) years from the date of installation and the energy recovery ventilator core shall have a limited warranty for a period of ten (10) years from the date of installation.
- B. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from the date of installation. In addition the compressor shall have a limited warranty for a period of seven (7) years from the date of installation.
- C. The units shall be covered by an extended manufacturer's limited warranty for a period of 5 years from the date of installation. For this to occur the system must be:
 - 1. Designed by a certified City Multi Diamond Designer.
 - 2. Installed by a certified City Multi Diamond Dealer.

3. Verified with a completed commissioning report submitted to Mitsubishi Electric Service Department.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Mitsubishi Electric and Electronics: www.mehvac.com
- B. Substitute equipment may be considered for approval that includes at a minimum:
 1. R-410a refrigerant
 2. Inverter compressor technology.
 3. Communication capability to EMS.
 4. Ability to meet all other provisions of the specifications herein and as specified on the drawings.

2.2 SYSTEM DESCRIPTION

- A. The variable capacity, split system heat pump heat recovery air conditioning system shall provide simultaneous cooling and heating.
- B. The system shall consist of an outdoor unit, Branch Circuit Controller, multiple indoor units, and manufacturer's Direct Digital Controls. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

2.3 OUTDOOR UNIT

- A. General:
 1. The outdoor unit shall be used specifically with specific components from the same manufacturer. The outdoor units shall be equipped with multiple circuit boards that interface to the manufacturer's direct digital controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
 2. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 64 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode

operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor

3. Both refrigerant lines from the outdoor unit to the Branch Circuit Controller (Single or Main) shall be insulated.
4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
5. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
8. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-2625 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
9. The outdoor unit shall have rated performance of heating operation at -13°F ambient temperatures and cooling mode down to 23°F ambient temperatures, without additional low ambient controls. The unit shall maintain 100% heat output at 0°F without a supplemental heat source or a second compressor to boost low ambient heating performance. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
10. The outdoor unit shall be capable of operating in cooling mode down to -4 F with optional manufacturer supplied low ambient kit.
11. Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.
12. Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
13. Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

14. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
15. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
16. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.

B. Heat Interchanger Circuit:

1. The outdoor unit shall contain a heat interchanger circuit for sub-cooling liquid prior to entering the outdoor coil during the heating mode.
2. The interchanger shall be of a copper tube within a tube construction.
3. The interchanger circuit refrigerant flow shall be controlled by an electronic expansion valve.

C. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished. Units cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models, when specified.

D. Fan:

1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

E. Refrigerant:

1. R410A refrigerant shall be required. A full charge of refrigerant for the condensing unit shall be provided in the condensing unit. Additional

refrigerant for the system shall be provided by the contractor.

2. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

F. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

G. Basepan Heater

1. Each outdoor unit module shall be equipped with a basepan heater. Basepan heater shall activate only when compressor is operating in heating mode at an outdoor ambient temperature of 39F or below. If an alternate manufacturer is selected, any additional material, cost, and labor to meet basepan heater condition and performance shall be incurred by the contractor.

H. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

I. Electrical:

1. The outdoor unit electrical power shall be 208 volts, 3-phase, 60 hertz.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts(208V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, Branch Circuit Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 BRANCH CIRCUIT (BC) CONTROLLERS

A. General:

1. The BC (Branch Circuit) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.
2. The BC (Branch Circuit) Controllers shall be specifically used with R410A VRFZ systems. These units shall be equipped with a circuit board that interfaces to the manufacturer's direct digital controls system and shall perform all functions necessary for operation. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.
3. Each VRF system shall include at least one (1) unused branches or branch devices for future use. Branches shall be fully installed & wired in central location with capped service shutoff valve & service port.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.

2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers with the exception of CMP-P104, 108NU-GB. These each contain (1) one.

C. Refrigerant:

1. The control circuit between the indoor units, BC Controller and the water-source unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.
2. R410A refrigerant shall be required.

D. Refrigerant Valves:

1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
2. Each branch shall have multiple two-position valves to control refrigerant flow.
3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

E. Integral Drain Pan:

1. An integral condensate pan and drain shall be provided.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz).
3. The BC Controller shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.5 INDOOR UNIT (WALL MOUNTED)

A. General:

1. The wall-mounted indoor unit shall have a modulating linear expansion device and a flat front. The unit shall support individual control using M-NET DDC controllers.

B. Indoor Unit

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.

3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz).

H. Controls:

1. This unit shall use controls provided by the manufacturer to perform functions necessary to operate the system.
2. The unit shall be able to control external backup heat.
3. The unit shall have a factory built in receiver for wireless remote control
4. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F deadband from set point.

2.6 INDOOR UNIT (4-WAY CEILING-RECESSED CASSETTE WITH GRILLE)

A. General:

1. The indoor unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Branch ducting shall be allowed from cabinet.
4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
7. Both refrigerant lines to the indoor units shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz).

G. Controls:

1. This unit shall use controls provided by the manufacturer to perform functions necessary to operate the system.
2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F deadband from set point.

2.7 INDOOR UNIT (CEILING-CONCEALED DUCTED)

A. General:

1. The indoor unit shall be a ceiling-concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The unit shall support individual control using

the manufacturers DDC controllers.

B. Indoor Unit.

1. The indoor unit shall be factory assembled, wired and run tested.
Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor.
The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The unit shall be, ceiling-concealed, ducted.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

D. Fan:

1. Units shall feature external static pressure settings from 0.14 to 0.60 in. WG.
2. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
3. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
4. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function
5. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter:

1. Return air shall be filtered by means of a standard factory installed return air filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.

4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The condensate shall be gravity drained from the fan coil.
7. Both refrigerant lines to the indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz).

H. Controls:

1. This unit shall use controls provided by the manufacturer to perform functions necessary to operate the system.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F deadband from set point.

2.8 CONTROLS

A. General:

1. The Manufacturer's Controls Network (MCN) consists of remote controllers, schedule timers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Manufacturer's Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces.
2. The MCN shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.

B. Wiring:

1. Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.
2. Control wiring shall be from the remote controller to the first associated indoor unit then to the remaining associated indoor units in a daisy chain configuration.

3. The system controller shall be capable of being networked with other system controllers for web based control.

C. Wiring Type:

1. Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire.
2. Network wiring shall be CAT-5e with RJ-45 connection.

D. Deluxe Remote Controller:

1. The Deluxe Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). The Deluxe Remote Controller shall be approximately 5" x 5" in size and white in color with a light-green LCD display, shall support a selection from multiple languages (Spanish, German, Japanese, Chinese, English, Russian, Italian, or French) for display information and shall support temperature display selection of Fahrenheit or Celsius. The Deluxe Remote Controller shall control the following grouped operations: On/Off, Operation Mode (cool, heat, auto, dry, and fan), temperature set point, fan speed setting, and airflow direction setting. The Deluxe Remote Controller shall support timer settings of on/off/temperature up to 8 times in a day in 1-minute increments. The Deluxe Remote Controller shall support an Auto Off timer. The room temperature shall be sensed at either the Deluxe Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Deluxe Remote Controller shall display a four-digit error code in the event of system abnormality/error.
2. The Deluxe Remote Controller shall only be used in the same group with other Deluxe Remote Controllers, with up to two remote controllers per group
3. The Deluxe Remote Controller shall require no addressing. The Deluxe Remote Controller shall connect using two-wire, stranded, non-polar control wire to the connection terminal on the indoor unit and require cross-over wiring for grouping across indoor units.

E. Controller:

1. The Centralized Controller shall be capable of controlling a maximum of 50 indoor units across multiple outdoor units. The Centralized Controller shall be approximately 7.5"x12" in size and shall be powered from a Power Supply Unit. The Centralized Controller shall support operation superseding that of the remote controllers, system configuration, daily/weekly/annual scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring.

The Centralized Controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto, dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance. The Centralized Controller shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Centralized Controller shall allow the user to define daily, weekly, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.

2. The Centralized Controllers shall be equipped with one RJ-45 Ethernet port to support interconnection with a network PC via a closed/direct Local Area Network (LAN).
3. The Centralized Controller shall be capable of performing initial settings via the 9" high-resolution, backlit, color touch panel on the controller or via a PC using the Centralized Controller's initial setting browser.
4. Standard software functions shall be available so that the building manager can securely log into each Controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics.
5. The Central Controller shall control and monitor the non-VRFZ ductless split systems through the use of an adaptor provided with the non-VRFZ systems.

F. BACNET® Interface:

1. The BACNET® interface shall support up to fifty indoor units with a variety of network variables on a per indoor unit basis. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.
2. The Central Controller shall control and monitor the non-VRFZ ductless split systems through the use of an adaptor provided with the non-VRFZ systems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

3.2 INSTALLATION

- A. Rig and install in full accordance with manufacturer's requirements, project drawings, and contract documents. Refer to the manufacturer's installation manual for full requirements.
- B. Location:
 - 1. Locate indoor and outdoor units as indicated on drawings. Provide service clearance per manufacturer's installation manual. Adjust and level outdoor units on support structure.
 - 2. For climates that experience snowfall, mount the outdoor unit a minimum of 12" above the average snowfall line. In climates where this height requirement proves unfeasible, the outdoor units may be installed at the average snowfall line provided regular snow removal in the area surrounding the units keeps the snow line below the bottom of the units
- C. Components / Piping:
 - 1. Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer's installation manual for full instructions.
 - 2. Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.
 - 3. Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-specific appurtenances are not allowed.
 - 4. Refrigerant pipe for CITY MULTI shall be made of phosphorus deoxidized copper, and has two types.
 - a. ACR "Annealed": Soft copper pipe, can be easily bent with human's hand.
 - b. ACR "Drawn Temper": Hard copper pipe (Straight pipe), being stronger than Type-O pipe of the same radical thickness.

- c. All refrigerant pipe connections shall be brazed and nitrogen purged. Mechanical fittings will not be permitted. Flared fittings are acceptable for connections to equipment.
- 5. The maximum operation pressure of R410A air conditioner is 4.30 MPa [623psi] . The refrigerant piping should ensure the safety under the maximum operation pressure. Refer to recommend piping specifications in Mitsubishi Electric's engineering manual. Pipes of radical thickness 0.7mm or less shall not be used.
- 6. Flare connection should follow dimensions provided in manufacturer's installation manuals.
- D. Pipe drain from cooling coils to nearest receptor or to grade.
- E. Contractor shall provide additional refrigerant for system.

END OF SECTION 23 81 28 238128

SECTION 238216 - AIR COILS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Electric coils.

1.3 RELATED REQUIREMENTS

- A. Section 15950 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 233100 - HVAC Ducts and Casings: Installation of duct coils.

1.4 REFERENCE STANDARDS

- A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).

1.5 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- C. Shop Drawings: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- D. Certificates: Certify that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- B. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.8 WARRANTY

- A. See Section 01770 - Project Closeout, for additional warranty requirements.

PART 2 PRODUCTS

2.1 ELECTRIC COILS

- A. Manufacturers:
 - 1. INDEECO (Industrial Engineering and Equipment Company) Model QUA: www.indeeco.com/#sle. (Basis of Design)
 - 2. Warren Technology
 - 3. Substitutions: See Section 230500 Mechanical General Conditions, Para 1.11 Equipment Deviations
- B. Assembly: UL listed and labelled, with terminal control box and hinged cover, splice box, coil, casing, and controls.
- C. Coil: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
- D. Casing: Slip in 16 gauge galvanized steel wit.
- E. Controls: Automatic reset thermal cut-out, built-in magnetic contactors, control circuit transformer and fuse , manual reset thermal cut-out , air flow proving device , fused disconnect , load fuses, SCR Control, BacNet interface card.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturers written instructions.
- B. Install in ducts and casings in accordance with SMACNA (DCS).
 - 1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.
 - 2. Provide frames for maximum three coil sections.

3. Arrange supports to avoid piercing drain pans.
 4. Provide airtight seal between coil and duct or casing.
 5. Refer to Section 233100.
- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install coils level.

END OF SECTION 238216

SECTION 260502.01 - ELECTRICAL GENERAL CONDITIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. Related Work Specified Elsewhere:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section..
 - 2. This section applies to certain sections of Division 1, Division 23, "Mechanical". This section applies to all sections of Division 26, "Electrical," of this project specification unless specified otherwise in the individual sections.
 - 3. Temporary Facilities and controls are specified in Section 01520. Cooperate in ensuring adequate protection.
 - 4. General material, equipment and workmanship standards are specified in Section 00700.
 - 5. Finished painting is specified in section 09900.
 - 6. Access doors and panels to be installed in finished surfaces are specified in Section 08311.

1.3 DRAWINGS AND COORDINATION

- A. It is not the intention of the drawings to show every item, piece of equipment and detail. Provide complete, operating systems.
- B. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Consult Engineer before making changes which affect the function or appearance of systems.
- C. Dimensions, elevations and locations are shown approximately. Verify actual conditions in the field.
- D. Owner, Architect, and Engineer reserve the right to order changes in layout of such items as switches, receptacles, and fixtures if such changes do not

substantially affect costs and if affected items have not been fabricated or installed.

- E. In some cases, drawings are based upon products of one or several manufactures as listed on the Contract Documents. This contractor shall be responsible for modifications made necessary by substitution of products of different manufacturers.
- F. Do not install part of a system until all critical components of the system and related systems have been approved. Coordinate parts of systems to ensure proper operation of the entire system.
- G. Install products in accordance with manufacturer's written instructions. Notify Engineer if Contract Documents conflict with manufacturer's instructions. Comply with Engineers interpretations.
- H. Provide brackets, supports, anchors and frames required for installation of work specified herein. Such metal work shall conform to the requirements of Section 16070.

1.4 REFERENCES

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- B. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- C. NEMA ICS 6 - National Electrical Manufacturers Association
- D. NEMA MG 10 - National Electrical Manufacturers Association.
- E. NEMA MG 11 - National Electrical Manufacturers Association.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association.
- G. SSPC-Paint 15 - Steel Joist Shop Paint; Society for Protective Coatings.
- H. IEEE 100 - Dictionary of Electrical and Electronics Terms.

1.5 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

- C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.6 CODES AND STANDARDS

- A. The Codes and Standards listed below apply to all Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision.
- B. The current adopted editions of the following State or local Codes apply:
 - 1. 2022 Connecticut State Building Code
 - 2. 2021 International Building Code
 - 3. 2021 International Mechanical Code
 - 4. 2021 International Plumbing Code
 - 5. 2020 National Electrical Code (NFPA 70)
 - 6. 2021 International Energy Conservation Code
 - 7. ICC/ANSI A117.1-2017 Accessible and Usable Buildings and Facilities
- C. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.
- D. Include in the Work, without extra cost to the Owner, any labor, materials, testing, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.7 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Provide manufacturer's ORIGINAL printed product data, catalog cuts and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.

- C. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.
- D. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.
- E. Submit drawings a minimum of 14 inches by 20 inches in size using a minimum scale of 1/8 inch per foot except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
- F. Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.
- G. Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the

specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

- H. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
- I. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.8 QUALITY ASSURANCE

A. Material and Equipment Qualifications

- 1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

B. Regulatory Requirements

- 1. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

C. Alternative Qualifications

- 1. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

- D. Service Support
 - 1. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
 - E. Manufacturer's Nameplate
 - 1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
 - F. Modification of References
 - 1. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Building Official or Inspector and/or Fire Marshal.
 - G. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
 - H. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.
 - I. Design Seismic bracing and restraints under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Connecticut.
 - J. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- 1.9 COORDINATION WITH OTHER DIVISIONS
- A. Carry out all work in conjunction with other trades and give full cooperation in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the General Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, access doors, etc. required by other trades, and to allow for serviceable access to equipment.

- B. Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference. In general, ductwork, heating piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer regarding the arrangement of work, which cannot be agreed upon by the Contractors, will make final decisions. Service of equipment will take precedence.
 - C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment.
 - D. If work is installed before coordinating with other Divisions or so as to cause interference with work of other Sections, the Contractor causing the interference will make necessary changes to correct the condition without extra charge to the Owner.
 - E. Initial contact and coordination has been conducted with utility entities for the purpose of the preparation of Bid Documents. The Contractor shall coordinate all final specific utility requirements.
- 1.10 PRE-INSTALLATION MEETING
- A. Convene one week before starting work of this section.
- 1.11 PROJECT CONDITIONS
- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
 - B. Sequence installation to conform with the project phasing indicated on the Architectural drawings.
- 1.12 WARRANTY
- A. See Section 01770 - Project Closeout, for additional warranty requirements.
 - B. Correct defective Work within a one year period after Date of Substantial Completion.
- 1.13 OPERATING INSTRUCTIONS
- A. Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections. The operating instructions shall include the following:
 - 1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 3. Safety precautions.
 4. The procedure in the event of equipment failure.
 5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.
- B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.14 ELECTRICAL REQUIREMENTS

- A. Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.
- B. Motors and Equipment
1. Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, including control wiring and conduit to conform with the requirements of the section covering the mechanical equipment.
Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring and conduit, the motor control equipment and the electrical power circuits shall be provided under Division 16.
- C. Wiring and Conduit
1. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment, the conduit and wiring connecting such assemblies, or other power sources to equipment. Power and Control wiring and conduit shall be provided under Division 16 and shall conform to the requirements of the section specifying the associated equipment.
 2. All wiring in finished areas shall be run concealed in ceilings, walls or floors unless otherwise indicated.
- D. New Work

1. Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring and conduit, the motor control equipment and the electrical power circuits shall be provided under Division 16, except internal wiring for components of packaged equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

E. High Efficiency Motors

1. Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.
2. Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

F. Instruction To Owners Personnel

1. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Owner personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications. Instructions and/or training shall be video taped. Provide the owner with

two copies of the video tape prior to project close out.

G. Lockout Requirements

1. Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

1.15 THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Refer to Division 7 Specification for additional and more specific information.
- B. Fire-stopping systems shall be submitted as shop drawing.
- C. Penetrations through fire-rated walls, ceiling or floors and penetrations through smoke barriers, smoke resistive construction, and construction enclosing compartmentalized areas involving both empty openings, openings containing penetration items, and openings due to flue decks shall be sealed with a U.L. approved fire-stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling or floor.
- D. Thruwall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 STARTING EQUIPMENT AND SYSTEMS

- A. Provide manufacturer's field representative to prepare and start equipment.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

3.3 CLEANING

- A. Clean the entire installation at substantial completion .

- B. Protect installed equipment from subsequent construction operations.

END OF SECTION 260502.01

SECTION 260519 - LOW-VOLTAGE POWER CONDUCTORS & CABLES (600 V & LESS)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wire and cable for 600 volts and less.
- D. Wiring connectors.
- E. Electrical tape.
- F. Wire pulling lubricant.
- G. Cable ties.

1.3 RELATED REQUIREMENTS

- A. Section 07841 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.

1.4 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).

- D. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- G. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.
- 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. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- P. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Wiles Architects of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.6 SUBMITTALS

- A. See Section 013300 - Submittals, for submittal procedures.
- B. Product Data: Provide for each cable assembly type.
- C. Test Reports: Indicate procedures and values obtained.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- F. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.9 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - b. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.
 - 2. In addition to other applicable restrictions, may not be used:
 - a. Where exposed to damage.
 - b. For damp, wet, or corrosive locations.
- D. Conductor sizes are based on copper. Aluminum conductors will not be accepted.

2.2 CONDUCTOR AND CABLE MANUFACTURERS

- A. Cerro Wire LLC: www.cerrowire.com.
- B. Industrial Wire & Cable, Inc: www.iewc.com.
- C. Southwire Company: www.southwire.com.
- D. Substitutions: See Section 016000 - Product Requirements.

2.3 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.

- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- H. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- I. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.

4) Neutral/Grounded: White.

b. Equipment Ground, All Systems: Green.

c. For control circuits, comply with manufacturer's recommended color code.

2.4 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

a. Cerro Wire LLC: www.cerrowire.com/#sle.

b. Encore Wire Corporation: www.encorewire.com/#sle.

c. Southwire Company: www.southwire.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:

a. Size 10 AWG and Smaller: Solid.

b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

F. Conductor: Copper.

G. Insulation Voltage Rating: 600 volts.

H. Insulation: NFPA 70 , Type THHN/THWN.

2.5 METAL-CLAD CABLE

A. Manufacturers:

1. AFC Cable Systems Inc: www.afcweb.com/#sle.

2. Encore Wire Corporation: www.encorewire.com/#sle.

3. Southwire Company: www.southwire.com/#sle.

- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Armor: Aluminum interlocked tape.
- I. Description: NFPA 70, Type MC.
- J. Conductor: Copper.
- K. Insulation Voltage Rating: 600 volts.
- L. Insulation Temperature Rating: 60 degrees C.
- M. Insulation Material: Thermoplastic.

2.6 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- C. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. NSI Industries LLC: www.nsiindustries.com/#sle.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.

- I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

1. Manufacturers:

- a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.

2.7 WIRING ACCESSORIES

- A. Electrical Tape:

1. Manufacturers:

- a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.

2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

- B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

- C. Cable Ties: Material and tensile strength rating suitable for application.

- D. Spring Wire Connectors:

- E. Compression Connectors:

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Verify that field measurements are as shown on the drawings.

- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:

1. All wiring shall be run concealed in finished areas. Install in ceiling spaces, wall stud space or below slab unless specifically indicated otherwise.
2. Unless dimensioned, circuit routing indicated is diagrammatic.
3. When circuit destination is indicated and routing is not shown, determine exact routing required.
4. Arrange circuiting to minimize splices.
5. Include circuit lengths required to install connected devices within 10 ft of location shown.
6. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

- B. Install products in accordance with manufacturer's instructions.

- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

- D. Install metal-clad cable (Type MC) in accordance with NECA 120.

- E. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

- F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- H. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
 - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
- I. Install conductors with a minimum of 12 inches of slack at each outlet.
- J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

- N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07841.
- R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- S. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- T. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

- 3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.
- U. Use wiring methods indicated.
- V. Pull all conductors into raceway at same time.
- W. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- X. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- Y. Clean conductor surfaces before installing lugs and connectors.
- Z. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- AA. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- BB. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- CC. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- DD. Identify and color code wire and cable under provisions of Section 260553.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective conductors and cables.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.
- E. Grounding and bonding components.

1.3 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Power Conductors & Cables (600 V & Less): Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.4 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2003.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Wiles Architects. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
4. Ground Rod Electrode(s):
 - a. Provide two electrodes unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape

(uncovered) area.

F. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.

8. Provide bonding for interior metal air ducts.

- H. Pole-Mounted Luminaires: Also comply with Section 265600.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

- B. Conductors for Grounding and Bonding, in addition to requirements of Section 260519:

1. Use insulated copper conductors unless otherwise indicated.

- C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use mechanical connectors or compression connectors for accessible connections.

- D. Ground Rod Electrodes:

1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

2.3 MANUFACTURERS

- A. Cooper Power Systems, a division of Cooper Industries:
www.cooperindustries.com.
- B. Framatome Connectors International: www.fciconnect.com.
- C. Erico: www.erico.com.

2.4 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.
- B. Wire: Stranded copper.

- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 4. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Provide bonding to meet requirements described in Quality Assurance.
- F. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions.
Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.3 RELATED REQUIREMENTS

- A. Section 260533.13 - Conduit: Additional support and attachment requirements for conduits.
- B. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- C. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- D. Conduit and equipment supports.
- E. Anchors and fasteners.

1.4 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Wiles Architects of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Hollow Masonry: Use toggle bolts.
 3. Hollow Stud Walls: Use toggle bolts.
 4. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 5. Wood: Use wood screws.

2.2 MANUFACTURERS

- A. Thomas & Betts Corporation: www.tnb.com.
- B. Threaded Rod Company: www.threadedrod.com.
- C. Caddy Fasteners: www.erico.com.

2.3 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 - 1. Obtain permission from Wiles Architects before using powder-actuated anchors.
 - 2. Concrete Structural Elements: Use precast inserts, expansion anchors, powder-actuated anchors, or preset inserts.
 - 3. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
 - 4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
 - 5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
 - 6. Solid Masonry Walls: Use expansion anchors or preset inserts.
 - 7. Wood Elements: Use wood screws.
- D. Formed Steel Channel:
- E. Powder-Actuated Anchors:
- F. Steel Spring Clips:

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.

- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Wiles Architects, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Wiles Architects, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- H. Conduit Support and Attachment: Also comply with Section 260533.13.
- I. Interior Luminaire Support and Attachment: Also comply with Section 265100.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.
- L. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.
- E. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 - 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 - 2. Do not drill or cut structural members.
- F. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.
- I. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 260529

SECTION 260533.13 - CONDUIT 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 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Electrical metallic tubing (EMT).
- E. Rigid polyvinyl chloride (PVC) conduit.
- F. Conduit fittings.
- G. Conduit, fittings and conduit bodies.

1.3 RELATED REQUIREMENTS

- A. Section 07841 - Penetration Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260533.16 - Boxes for Electrical Systems.

1.4 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- E. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.

- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- H. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- I. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- J. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- K. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- L. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 01330 - Submittals, for submittals procedures.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.
- C. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Control Circuits: 3/4 inch trade size.
 - 3. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
 - 4. Underground, Interior: 3/4 inch (21 mm) trade size.
 - 5. Underground, Exterior: 1 inch (27 mm) trade size.
- D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.2 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.3 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 - 2. Electri-Flex Company: www.electriflex.com/#sle.
 - 3. International Metal Hose: www.metalhose.com/#sle.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction.

E. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:

1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

D. Description: Interlocked steel construction with PVC jacket.

E. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube Company: www.wheatland.com/#sle.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.6 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 1. Lamson & Sessions (Carlon); www.carlon.com
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.7 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. All conduits shall be run concealed in finished areas. Install in ceiling spaces, wall stud space or below slab unless specifically indicated otherwise.
- B. Verify that field measurements are as shown on drawings.

- C. Verify that mounting surfaces are ready to receive conduits.
- D. Verify that conditions are satisfactory for installation prior to starting work.
- E. Verify routing and termination locations of conduit prior to rough-in.
- F. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - 5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 - 8. Arrange conduit to provide no more than 150 feet between pull points.
 - 9. Route conduits above water and drain piping where possible.
 - 10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:

D. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Connections and Terminations:

1. Use suitable adapters where required to transition from one type of conduit to another.
2. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
3. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
4. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

F. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- G. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
- H. Provide grounding and bonding in accordance with Section 260526.
- 3.3 CLEANING
- A. Clean interior of conduits to remove moisture and foreign matter.
- 3.4 PROTECTION
- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.
- 3.5 INTERFACE WITH OTHER PRODUCTS
- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07841.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation specified.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Floor boxes.
- D. Underground boxes/enclosures.
- E. Wall and ceiling outlet boxes.
- F. Pull and junction boxes.

1.3 RELATED REQUIREMENTS

- A. Section 07841 - Penetration Firestopping.
- B. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- F. Section 262726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
- G. Section 262726 - Wiring Devices: Wall plates in finished areas.

1.4 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- H. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Wiles Architects of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for underground handhole enclosures, underground handhole enclosures, underground handhole enclosures, and underground handhole enclosures.
- C. Maintenance Materials: Furnish the following for Town of Trumbull's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.
- D. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 5. Use suitable concrete type boxes where flush-mounted in concrete.
 6. Use suitable masonry type boxes where flush-mounted in masonry walls.
 7. Use raised covers suitable for the type of wall construction and device configuration where required.
 8. Use shallow boxes where required by the type of wall construction.
 9. Do not use "through-wall" boxes designed for access from both sides of wall.
 10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 12. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
 13. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 14. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 15. Wall Plates: Comply with Section 262726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
3. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.

D. Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

E. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Applications:
 - a. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.

2.2 MANUFACTURERS

- A. Appleton Electric: www.appletonelec.com.

- B. Arc-Co./Division of Arcade Technology: www.arc-co.com.
- C. Unity Manufacturing: www.unitymfg.com.
- D. Substitutions: See Section 016000 - Product Requirements.

2.3 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- C. Wall Plates for Finished Areas: As specified in Section 262726.
- D. Floor Boxes: NEMA OS 1, fully adjustable, minimum 1-1/2 inches deep.

2.4 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 262716.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
 - 1. Material: Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes so that wall plates do not span different building finishes.
 - 4. Locate boxes so that wall plates do not cross masonry joints.
 - 5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 7. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - 8. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
- G. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- H. Install boxes plumb and level.
- I. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- J. Install boxes as required to preserve insulation integrity.
- K. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- L. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
 2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 260526.
- R. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

- S. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- T. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- U. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- V. Maintain headroom and present neat mechanical appearance.
- W. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- X. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07841.
- Y. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- Z. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- AA. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- BB. Locate outlet boxes so that wall plates do not span different building finishes.
- CC. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.
- DD. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- EE. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- FF. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- GG. Use adjustable steel channel fasteners for hung ceiling outlet box.
- HH. Do not fasten boxes to ceiling support wires.
- II. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- JJ. Use gang box where more than one device is mounted together. Do not use sectional box.

KK. Use gang box with plaster ring for single device outlets.

LL. Use cast outlet box in exterior locations exposed to the weather and wet locations.

3.3 ADJUSTING

A. Install knockout closures in unused box openings.

3.4 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.5 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

B. Clean exposed surfaces and restore finish.

END OF SECTION 260533.16

SECTION 260553 - 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 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.
- E. Warning signs and labels.

1.3 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Power Conductors & Cables (600 V & Less): Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 262726 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.4 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals, for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.8 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

- 2) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

2. Service Equipment:

- a. Use identification nameplate to identify each service disconnecting means.
3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
4. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
5. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
6. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Date label applied.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 5. Use underground warning tape to identify direct buried cables.
- C. Identification for Devices:
1. Use identification label to identify fire alarm system devices.
 2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

2.2 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.
- C. HellermannTyton: www.hellermannntyton.com.

2.3 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- D. Locations:
1. Each electrical distribution and control equipment enclosure.
 2. Communication cabinets.
- E. Letter Size:
1. Use 1/8 inch letters for identifying individual equipment and loads.
 2. Use 1/4 inch letters for identifying grouped equipment and loads.
- F. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles and control device stations. .

2.4 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.
- G. Description: Cloth type wire markers.
- H. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- I. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.5 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
 1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.6 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conductors and Cables: Legible from the point of access.
 - 8. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION 260553

SECTION 260919 - ENCLOSED CONTACTORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

1.3 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.4 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide dimensions, size, voltage ratings and current ratings.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Allen-Bradley/Rockwell Automation: www.ab.com/#sle.
- B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

2.2 GENERAL PURPOSE CONTACTORS

- A. Coil operating voltage: 120 volts, 60 Hertz.
- B. Poles: As required to match circuit configuration and control function.
- C. Enclosure: NEMA ICS 6, Type 1.
- D. Accessories:
 - 1. Auxiliary Contacts: One, normally open.

2.3 LIGHTING CONTACTORS

- A. Configuration: Electrically held.
- B. Coil operating voltage: 120 volts, 60 Hertz.
- C. Poles: As required to match circuit configuration and control function.
- D. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- E. Enclosure: NEMA ICS 6, Type 1.
- F. Accessories:
 - 1. Auxiliary Contacts: One, normally open.

2.4 ACCESSORIES

- A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA ICS 5, standard type.
- C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
- D. Pushbuttons: Unguarded type.
- E. Indicating Lights: Transformer, LED type.

- F. Selector Switches: Rotary type.
- G. Relays: NEMA ICS 2, .
- H. Control Power Transformers: 120 volt secondary, 50 VA minimum, in each enclosed contactor. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.5 DISCONNECTS

- A. Combination Contactors: Combine contactor with disconnect in common enclosure.
- B. Disconnects: Thermal magnetic circuit breaker with integral thermal and instantaneous magnetic trip in each pole; UL listed.
- C. Disconnects: Fusible switch assembly; NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class R fuses.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 260529.
- C. Provide engraved plastic nameplates; refer to Section 260553 for product requirements and location.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Perform applicable inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 260919

SECTION 262100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical service requirements.

1.2 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Notify Wiles Architects of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 1. IEEE C2 (National Electrical Safety Code).
 2. NFPA 70 (National Electrical Code).
 3. The requirements of the Utility Company.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: United Illuminating.

- D. Division of Responsibility:
 - 1. Pole-Mounted Utility Transformers:
 - a. Utility Poles: Furnished and installed by Utility Company.
 - b. Transformers: Furnished and installed by Utility Company.
 - c. Transformer Grounding Provisions: Furnished and installed by Utility Company.
 - d. Primary: Furnished and installed by Utility Company.
 - e. Secondary - Underground Service:
 - 1) Conduits: Furnished and installed by Contractor.
 - 2) Conductors: Furnished and installed by Contractor (Service Point at utility pole).
 - 2. Terminations at Service Point: Provided by Utility Company.
 - 3. Metering Provisions:
 - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.

- D. Provide required support and attachment components in accordance with Section 260529.
- E. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.
- F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

END OF SECTION 262100

SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.

1.3 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.

1.4 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- F. NEMA PB 1 - Panelboards; 2011.
- G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- 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. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- L. UL 67 - Panelboards; Current Edition, Including All Revisions.
- M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Wiles Architects of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information,

and installed features and accessories.

1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- G. Maintenance Materials: Furnish the following for Town of Trumbull's use in maintenance of project.
 1. Panelboard Keys: Two of each different key.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.10 MAINTENANCE MATERIALS

- A. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.
- B. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- C. Siemens; www.siemens.com.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- H. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- I. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs and feeders as indicated or as required to interconnect sections.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Copper suitable for terminating copper conductors only.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.

- D. Circuit Breakers:
 - 1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide clear plastic circuit directory holder mounted on inside of door.
- F. Description: NEMA PB 1, circuit breaker type.
- G. Service Conditions:
 - 1. Altitude: 3300 feet.
 - 2. Temperature: 90 degrees F.
- H. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
 - 1. 208 Volt Panelboards: 22,000 amperes rms symmetrical.
- I. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
- J. Molded Case Circuit Breakers with Current Limiters: With replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole; UL listed.
- K. Current Limiting Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole: UL listed. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- L. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay.
 - 1. Coil operating voltage: 120 volts, 60 Hz.
 - 2. Coil operating voltage: 120 volts, DC.

3. Size as shown on Drawings.
 4. Provide unit mounted control power transformer, RED indicating light in front cover.
- M. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- N. Enclosure: NEMA PB 1, Type 1, 24 inches deep, 6 inches wide minimum, cabinet box.
- O. Cabinet Front: Flush or surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

- F. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard ; provide insulated ground bus where scheduled.
- H. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
 - 1. Type SWD for lighting circuits.
 - 2. Type HACR for air conditioning equipment circuits.
 - 3. Class A ground fault interrupter circuit breakers where scheduled.
 - 4. Do not use tandem circuit breakers.
- I. Current Limiting Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole; UL listed. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- J. Enclosure: NEMA PB 1, Type 1.
- K. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.
- L. Cabinet Front: Flush cabinet front with door in door construction, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Copper suitable for terminating copper conductors only.

3. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
4. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
5. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
6. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NEMA PB 1.1, NECA 1 (general workmanship), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 260529.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

- H. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- I. Provide grounding and bonding in accordance with Section 260526.
- J. Install all field-installed branch devices, components, and accessories.
- K. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.
- L. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- M. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- N. Provide filler plates to cover unused spaces in panelboards.
- O. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.
- P. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- Q. Ground and bond panelboard enclosure according to Section 260526.

3.3 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 014000.
- B. Perform field inspection and testing in accordance with Section 014000.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Test GFCI circuit breakers to verify proper operation.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.
- F. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.

1.3 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 07841 - Penetration Firestopping
- D. Section 260533.16 - Boxes for Electrical Systems.

1.4 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and

Supplements.

- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
- 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
- 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
- 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
- 5. Notify Wiles Architects of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

- 1. Do not install wiring devices until final surface finishes and painting are complete.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for

storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data:

1. GFI Receptacles: Include information on status indicators and testing procedures and intervals.

E. Project Record Documents: Record actual installed locations of wiring devices.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.
- B. Products: Provide products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.9 EXTRA MATERIALS

- A. Furnish two of each style, size, and finish wall plate.
- B. Provide two protective rings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell Incorporated;; www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc;; www.leviton.com.
- C. Pass & Seymour, a brand of Legrand North America, Inc;; www.legrand.us
- D. Source Limitations: Where possible, for each type of wiring device furnish products produced by a single manufacturer and obtained from a single

supplier.

2.2 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with "weatherproof while in use" covers for all receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for all receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. For flush floor service fittings, use tile rings for installations in tile floors.
- G. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.3 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Access Floor Boxes: White wiring devices with gray steel cover with insert to match floor covering.

2.4 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.5 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated;; www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc;; www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc;; www.legrand.us/#sle.

- B. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Commercial specification grade, 15 A, 120 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.6 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc;: www.leviton.com/#sle.
 - 2. Pass & Seymour, a brand of Legrand North America, Inc;: www.legrand.us/#sle.
- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Control: Slide control type with separate on/off switch.
- D. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
 - 1. Magnetic Low-Voltage: 600 VA.
 - 2. Electronic Low-Voltage: 400 VA.

2.7 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated;: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc;: www.leviton.com/#sle.
 - 3. Lutron Electronics Company, Inc: www.lutron.com/#sle.

- B. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498 and where applicable FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Commercial specification grade, 15A, 125V, NEMA 5-15R; single or duplex as indicated on the drawings.
 - 2. Automatically Controlled Convenience Receptacles: Commercial specification grade, 15A, 125V, NEMA 5-15R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
 - 3. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFI Receptacles:
 - 1. All GFI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
 - 2. Standard GFI Receptacles: Commercial specification grade, duplex, 15A, 125V, NEMA 5-15R, rectangular decorator style.
 - 3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 15A, 125V, NEMA 5-15R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.8 WALL PLATES

- A. Manufacturers:
 - 1. Hubbell Incorporated;: www.hubbell-wiring.com/#sle.
 - 2. Leviton Manufacturing Company, Inc;: www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc;: www.legrand.us/#sle.

4. Substitutions: See Section 016000 - Product Requirements.
- B. All Wall Plates: Comply with UL 514D.
 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard;.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- E. Weatherproof Cover Plates: Gasketed with hinged cover rated "Weatherproof while in use".

2.9 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
 1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 2. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
 3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
- B. Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
 1. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: Two standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2) Communications: _____.
 - 3) Voice and Data Jacks: Provided by others.
 2. Accessories:

- a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
- b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFI receptacles with integral GFI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- P. Install receptacles with grounding pole on top.
- Q. Connect wiring device grounding terminal to outlet box with bonding jumper.
- R. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- S. Connect wiring devices by wrapping conductor around screw terminal.
- T. Use jumbo size plates for outlets installed in masonry walls.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260537 to obtain mounting heights specified.
- B. Install convenience receptacle 18 inches above finished floor.
- C. Install convenience receptacle 6 inches above counter.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

SECTION 262816.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Enclosed safety switches.
- B. Nonfusible switches.

1.3 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.4 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002.
- D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

- I. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- J. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Wiles Architects of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.6 SUBMITTALS

- A. See Section 01330 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Project Record Documents: Record actual locations of enclosed switches.

- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Town of Trumbull's use in maintenance of project.
 - 1. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com/#sle.
- B. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- C. Siemens; www.siemens.com.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- L. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:

- a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.3 COMPONENTS

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.

1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
2. Handle lockable in OFF position.
3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.

- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.

1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
2. Handle lockable in OFF position.

- C. Enclosures: NEMA KS 1.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 260529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- I. Provide identification nameplate for each enclosed switch in accordance with Section 260553.
- J. Provide identification label on inside door of each fused switch indicating NEMA fuse class and size installed in accordance with Section 260553.
- K. Provide arc flash warning labels in accordance with NFPA 70.
- L. Provide floor markings to clearly indicate required working clearances where required by the authority having jurisdiction.
- M. Install fuses in fusible disconnect switches.
- N. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.16

SECTION 263600 - TRANSFER SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
 - 1. Automatic transfer switches.
- B. Automatic Transfer Switch.

1.3 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 263213 - Engine Generators: For interface with transfer switches.
- E. Section 263213 - Engine Generators: Testing requirements.

1.4 REFERENCE STANDARDS

- A. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2005.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work with placement of supports, anchors, etc. required for mounting.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
- C. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
- D. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation Data: Instructions for operating equipment under emergency conditions when engine generator is running.
- G. Maintenance Data: Routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.7 QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70 (National Electrical Code).
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

- C. Conform to requirements of NFPA 70.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- E. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.
- F. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Transfer Switches:
 - 1. ASCO Power Technologies, a brand of Emerson Network Power:
www.emersonnetworkpower.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
- B. Russelectric: www.russelectric.com.
- C. Substitutions: See Section 016000 - Product Requirements.

2.2 TRANSFER SWITCHES

- A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Applications:
 - 1. Utilize open transition transfer unless otherwise indicated or required.
- D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
- E. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

- F. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
 - G. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.
 - H. Switching Methods:
 - 1. Open Transition:
 - a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
 - 2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.
 - I. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
 - J. Enclosures:
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Finish: Manufacturer's standard unless otherwise indicated.
 - K. Short Circuit Current Rating:
 - 1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.
- 2.3 AUTOMATIC TRANSFER SWITCH
- A. Description: NEMA ICS 10, open transition automatic transfer switch .
 - B. Configuration: Electrically operated, mechanically held transfer switch.
- 2.4 SERVICE CONDITIONS
- A. Service Conditions: NEMA ICS 10.

- B. Temperature: 95 degrees F.
- C. Altitude: 5000 feet.

2.5 COMPONENTS

- A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE.
- B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
- C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate source to normal source.
- D. Transfer Switch Auxiliary Contacts: 1 normally open; 1 normally closed.
- E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 percent from rated nominal value.
- F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent from rated nominal value.
- G. In-Phase Monitor: Inhibit transfer until source and load are within 10 electrical degrees.
- H. Switched Neutral: Overlapping contacts.
- I. Enclosure: ICS 10, Type 1, finished with manufacturer's standard gray enamel.

2.6 AUTOMATIC SEQUENCE OF OPERATION

- A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
- B. Time Delay To Start Alternate Source Engine Generator: 0 to 2 seconds, adjustable.
- C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
- D. Time Delay Before Transfer to Alternate Power Source: 0 to 5 seconds, adjustable.
- E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

- F. Time Delay Before Transfer to Normal Power: 0 to 90 seconds, adjustable; bypass time delay in event of alternate source failure.
- G. Time Delay Before Engine Shut Down: 0 to 30 minutes, adjustable, of unloaded operation.
- H. Engine Exerciser: Start engine every 7 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.
- I. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
- B. Verify that rough-ins for field connections are in the proper locations.
- C. Verify that mounting surfaces are ready to receive transfer switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Arrange equipment to provide minimum clearances and required maintenance access.
- B. Install transfer switches plumb and level.
- C. Provide grounding and bonding in accordance with Section 260526.
- D. Identify transfer switches and associated system wiring in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Perform field inspection and testing in accordance with Section 014000.
- C. Inspect and test in accordance with NETA STD ATS, except Section 4.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.22.3.

3.4 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.

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Project No. 20-080

END OF SECTION 263600 263600

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Emergency lighting units.
- B. Exit signs.

1.3 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.

1.4 REFERENCE STANDARDS

- A. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004.
- B. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- C. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- F. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 101 - Life Safety Code; 2015.
- I. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

- J. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
- 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

1.6 SUBMITTALS

A. Shop Drawings:

- 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- 2. Provide photometric calculations where luminaires are proposed for substitution upon request.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.

D. Field Quality Control Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of

product.

- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.7 QUALITY ASSURANCE

- A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- B. Conform to requirements of NFPA 70 and NFPA 101.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.9 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.

- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.4 EXIT SIGNS

- A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- B. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.
- C. Self-Powered Exit Signs:
 - 1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.

2.5 BALLASTS AND DRIVERS

- A. All Ballasts:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- B. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- B. Verify that suitable support frames are installed where required.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide required support and attachment in accordance with Section 260529.
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each

recessed luminaire to building structure.

7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

F. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

H. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).

I. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

J. Connect luminaires and exit signs to branch circuit outlets provided under Section 260537 using flexible conduit.

K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

L. Install specified lamps in each luminaire.

M. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

N. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

O. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.4 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Perform field inspection in accordance with Section 014000.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Wiles Architects.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Wiles Architects. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Wiles Architects or authority having jurisdiction.

3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Wiles Architects, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Exterior luminaires.
- B. Poles and accessories.

1.3 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.

1.4 REFERENCE STANDARDS

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 1994 (R 2003).
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004.
- C. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.
- D. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
- E. IEEE C2 - National Electrical Safety Code; 2012.
- F. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).
- G. IESNA LM-64 - Photometric Measurements of Parking Areas; 2001 (Reaffirmed 2007).
- H. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- I. IES RP-8 - Roadway Lighting; 2014.

- J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2011.
- K. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- N. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- O. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
- P. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- Q. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.

1.6 SUBMITTALS

- A. See Section 013300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard product of the manufacturer.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions,

photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.

- E. Test Reports: Indicate measured illumination levels.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- H. Project Record Documents: Record actual connections and locations of luminaires, and any pull or junction boxes.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Electrical Components: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.9 EXTRA MATERIALS

- A. See Section 016000 - Product Requirements, for additional provisions.
- B. Furnish four of each type and wattage lamp installed.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

2.3 POLES

- A. All Poles:
 - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
- B. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- B. Verify that suitable support frames are installed where required.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Pole-Mounted Luminaires:

1. Foundation-Mounted Poles:

- a. Install foundations plumb.
- b. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
- c. Tighten anchor bolt nuts to manufacturer's recommended torque.

2. Grounding:

- a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.

3. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.

- B. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

3.4 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Perform field inspection, testing, and adjusting in accordance with Section 014000.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Wiles Architects.

3.5 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and

restore finishes to match original factory finish.

- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Wiles Architects, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed.

3.7 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

3.8 SCHEDULE - ATTACHED

END OF SECTION 265600

SECTION 284600 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.

1.3 RELATED REQUIREMENTS

- A. Section 078413 - Penetration Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 211300 - FIRE SUPPRESSION SPRINKLERS: Supervisory, alarm, and actuating devices installed in sprinkler system.

1.4 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Cor 1, 2012).
- D. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage Power Circuits; 1991 (R1995).
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 72 - National Fire Alarm Code and Signaling Code 2019
- G. NFPA 101 - Life Safety Code; 2015.
- H. Connecticut State Fire Safety Code; 2021.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Proposed maintenance contract.
 - 4. Battery calculations.
- C. Drawings must be prepared using AutoCAD Release 2008 or newer.
 - 1. Architect will provide floor plan drawings for Contractor's use; verify all dimensions on Architect-provided drawings.
- D. Evidence of designer qualifications.
- E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 4. System zone boundaries and interfaces to fire safety systems.
 - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 - 7. List of all devices on each signaling line circuit, with spare capacity indicated.
 - 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.

9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
- F. Evidence of installer qualifications.
- G. Evidence of instructor qualifications; training lesson plan outline.
- H. Evidence of maintenance contractor qualifications, if different from installer.
- I. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- J. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Town of Trumbull.
 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

- K. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
 - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 - 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- L. Closeout Documents:
 - 1. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to Town of Trumbull upon completion.
- B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Alarm Control Units - Basis of Design: Honeywell Security & Fire Solutions/Notifier ; _____ : www.notifier.com.
- B. Initiating Devices, and Notification Appliances:
 - 1. Same manufacturer as control units.
 - 2. Provide all initiating devices and notification appliances made by the same manufacturer.
- C. Substitutions: See Section 016000 - Product Requirements.

2.2 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 - 1. Protected Premises: Entire building shown on drawings.
 - 2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the State Fire Marshal.
 - c. The requirements of the local authority having jurisdiction .
 - d. Applicable local codes.
 - e. NFPA 101.
 - f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
 - 3. Evacuation Alarm: Single smoke zone; general evacuation of entire premises.
 - 4. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all areas of the building.
 - 5. Master Control Unit (Panel): New, located at location indicated on plans.
 - 6. Combined Systems: Do not combine fire alarm system with other non-fire systems.

- B. Supervising Stations and Fire Department Connections:
 - 1. Remote Supervising Station: UL-listed central station under contract to facility.
 - 2. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.
- C. Circuits:
 - 1. Initiating Device Circuits (IDC): Class B, Style A.
 - 2. Notification Appliance Circuits (NAC): Class B, Style W.
- D. Spare Capacity:
 - 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 - 3. Speaker Amplifiers: Minimum 25 percent spare capacity.
- E. Power Sources:
 - 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 - 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.3 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.
 - 2. Dry-pipe sprinkler system pressure.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 - 1. Sprinkler water flow.
 - 2. Manual pull stations.
 - 3. Smoke detectors.

2.4 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Remote Annunciators: _____.
- D. Initiating Devices:
 - 1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
 - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
 - 2. Manual Pull Stations:
 - 3. Smoke Detectors:
 - 4. Addressable Interface Devices:
- E. Notification Appliances:
 - 1. Horns and Mini-horns:
 - 2. Strobes:
- F. Surge Protection: In accordance with IEEE C62.41 B3 combination waveform and NFPA 70.
 - 1. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- B. Obtain Town of Trumbull's approval of locations of devices, before installation.
- C. Install instruction cards and labels.

3.2 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Town of Trumbull 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - 1. Record all system operations and malfunctions.
 - 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 - 3. Town of Trumbull will provide attendant operator personnel during diagnostic period; schedule training to allow Town of Trumbull personnel to perform normal duties.
 - 4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.3 TOWN OF TRUMBULL PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Town of Trumbull personnel:

1. Hands-On Instruction: On-site, using operational system.
 2. Classroom Instruction: Town of Trumbull furnished classroom, on-site or at other local facility.
 3. Factory Instruction: At control unit manufacturer's training facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
1. Initial Training: 1 session pre-closeout.
 2. Refresher Training: 1 session post-occupancy.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
1. Initial Training: 1 session pre-closeout.
 2. Refresher Training: 1 session post-occupancy.
- D. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
1. Initial Training: One 3-day session, pre-closeout.
 2. Refresher Training: One 1-day session post-occupancy.
- E. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- F. Video tape all training sessions and provide a minimum of two copies to Owner.

3.4 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Town of Trumbull.
1. Be prepared to conduct any of the required tests.
 2. Have authorized technical representative of control unit manufacturer present during demonstration.
 3. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 4. Repeat demonstration until successful.

- B. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
 - 1. Specified diagnostic period without malfunction has been completed.
 - 2. Approved operating and maintenance data has been delivered.
 - 3. All aspects of operation have been demonstrated to Town of Trumbull.
 - 4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 - 5. Specified pre-closeout instruction is complete.
- C. Perform post-occupancy instruction within 3 months after Substantial Completion.

3.5 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Town of Trumbull, a proposal as an alternate to the base bid, for a maintenance contract for entire warranty period, to include the work described below; include the total cost of contract, proposal to be valid at least until 30 days after date of Substantial Completion.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 - 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 - 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 - 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Town of Trumbull:
 - 1. Provide on-site response within 2 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Town of Trumbull.
 - 3. Town of Trumbull will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Town of Trumbull's representative upon completion of site visit.
- G. Comply with Town of Trumbull's requirements for access to facility and security.