PROJECT MANUAL GREENWOOD LAKE UNION FREE SCHOOL DISTRICT

2023 CAPITAL IMPROVEMENT PROJECT

1247 Lakes Road

Monroe, New York 10950

VOLUME 2

CPL PROJECT NO.: R23.00331.00 DOCUMENT DATE: October 28, 2024

NEW YORK STATE EDUCATION DEPARTMENT CONTROL NUMBER(S):

Building Name: Greenwood Lake Middle School Greenwood Lake Elementary School Control Number: 44-21-11-02-0-001-027 44-21-11-02-0-002-016

DESIGN PROFESSIONALS CERTIFICATION

The undersigned certifies that, to the best of his or her knowledge, information and belief, that the "Design conforms to all applicable provisions of the current New York State Uniform Fire Prevention Code, Building Code and Energy Conservation Code and that the "Work will not involve known or suspected ACBM".

ARCHITECT / ENGINEER:

CPL 26 IBM Road Poughkeepsie , New York 12601 (845)567-6700 OWNER: Greenwood Lake Union Free School District PO Box 8 Greenwood Lake, New York 10925 (845) 782-8678



Greenwood Lake Union Free School DistrictGreenwood Lake UFSD - 2023 Capital ProjectR23.00331.00Hydraulic Elevators142400 - 1

SECTION 142400 HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modernization of hydraulic elevator systems.1. Passenger type.

1.02 REFERENCE STANDARDS

- A. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. NFPA 13 Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Submit data on following items:
 - 1. Signal and operating fixtures, operating panels, and indicators.
 - 2. Car design, dimensions, layout, and components.
 - 3. Car and hoistway door and frame details.
 - 4. Electrical characteristics and connection requirements.

1.04 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hydraulic Elevator Manufacturers:
 - 1. TK Elevator; ____: www.tkelevator.com/#sle.
- B. Substitutions: See Section 016000 Product Requirements.

2.02 HYDRAULIC ELEVATORS MODERNIZATION

- A. Existing Hydraulic Passenger Elevator, TKE Serial # EG9632:
 - 1. Speed 100 fpm
 - 2. 2 Stops (2 Front / 0 Rear)
 - 3. Capacity: 2100 lbs
- B. New TK TAC-32 Microprocessor Non-Propreitary Controller
 - 1. Tenant Security Provisions 3-1 (Card Reader with override switch)
 - 2. MAX V2 Remote Monitoring Kit
 - 3. TAC 32 Controller (Includes Options listed below)
 - a. 24 VDC Signal Voltage
 - b. Auto Light and Fan Feature
 - c. Car Independent Service
 - d. Car Traveling Lantern Circuitry
 - e. Door Bypass Operation
 - f. Electronic Door Detector Interface

Greenwood Lake Union Free School District Gr R23.00331.00 Hydraulic Elevators

Greenwood Lake UFSD - 2023 Capital Project ators 142400 - 2

- g. Hoistway Access andf Enable
- h. THY Board
- 4. eMax Monitoring Device Provisions
- 5. Battery Lowering in Controller
- 6. Solid State Starters (6 or 12 Leads) 208 VAC
- 7. Viscosity Control (Required over 150 FPM)
- 8. Remote BCC and Separate Machine Room Wiring for 2019 New York Communciations Code
- C. Reuse Existing Power Unit
 - 1. Provide New Over-Speed Valve Kit for 2" oil line.
 - 2. Provide all new hydraulic fluid.
 - 3. Provide new hydrualic valve assembly
- D. Reuse Existing Jack Assembly
- E. Car Misc. Provide the following:
 - 1. New Crosshead data tag
 - 2. New 21" Toe guard
 - 3. New Fan: Two Speed
 - 4. New Car Top Exit Switch
 - 5. Includes2019 Two-way Communication Camera (dome), Ether Extender (kit), & Battery Backup
 - 6. Includes Cab Wiring Material (200MK1)
- F. New Hoistway Equipment
 - 1. Base Wiring Package for 2019 Code
 - 2. HN Boxes (per each 2 cars, grouped)
 - 3. Steel Tape with Mounting hardware, Selector and magnets (terminal limits included)
 - 4. TAC 32 Field Friendly Wiring Package Includes single traveling cable, hoistway wiring, interlock wiring, interlock connectors, and serial wiring.
 - 5. Hoistway Duct Kit
- G. Cab
 - 1. re
 - 2. Provide New Car Door (SSSS,#4 S/S (441))
- H. New Door Equipment
 - 1. Provide New Interlock / Pick up Assemblies for existing Dover Operators. Includes closers.
 - 2. Provide New LD-16 Plus Door Operator with Complete car-side equipment (FRONT)
 - a. includes Adapter kit (Tracks & Hangars), Clutch (w/ Car Door Lock latch & contact), Car Top Inspection station (w/ alarm signal)
 - 3. Provide New Micro Light 3D Door Detector Edge for 2019 Code Requirements.
 - 4. Includes 3D Cabsafe Components Package (2019 Emergency Communciations Code)
- I. New Car Fixtures
 - 1. Main Car Station Includes Options Below
 - a. Swing Return (Mini Swing (Column type) for New/ Existing Dover/tkE Cabs)
 - 2. Reuse Back Box
 - 3. Debranded Car Station (No Logo)
 - 4. Vandal Resistant Floor Bottons
 - 5. Cast Braille Plates for Car Features

Greenwood Lake Union Free School DistrictGrR23.00331.00Hydraulic Elevators

6. Standard Key Switch Package

- a. Fan
- b. Light
- c. Independent
- d. Stop
- e. Inspection/ Hoistway Enable
- 7. Emergency Light mounted in COP
- 8. Fire Service Phase II Features (includes instructions signage)
- 9. Handicap Signal (Passing signal)
- 10. Two-way Comminication Position Indicator
- 11. ADA Phone Sysytem integral with COP (Rath)
- 12. Speaker Pattern for Intercom System/ ADA Phone
- 13. Locked Service Cabinet
- 14. Certificate Window
- 15. Default Engravings
- 16. GFI Outlet
- 17. #4 Stainless Steel Finish (441)
- 18. Emergency Light Test Button
- 19. Voice Annunciator (mounted in COP)
- 20. Smart Rescue Phone 5 Standalone
- 21. Two-way Communication Machine Room Equipment (Primary Box)
- J. Hall Fixtures
 - 1. Fire Service Phase I Key Switch
 - 2. Fire Service Phase I Engraved Instructions
 - 3. Fusion Hall Lanterns (standard) White Up/Down LED's #4 S/S (304)
 - 4. Hoistway Jamb Braille
 - 5. Car Identificatioin Plate
 - 6. Hoistway Access Switches
 - 7. Terminal Hall Stations (Surface Mounted) with
 - a. Appendix O (Polycarbonate insert flame with engraved verbiage)b. Fusion (#4 S/S (304))
 - 8. Elevator Communications Failure signal

END OF SECTION 142400

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R23.00331.00

Greenwood Lake UFSD - 2023 CIP COMMON WORK RESULTS FOR PLUMBING

220500 - 1

SECTION 220500 COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- Α. This Section includes the following:
 - Piping materials and installation instructions common to most piping systems. 1.
 - Transition fittings. 2.
 - 3. Mechanical sleeve seals.
 - Sleeves. 4.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - Concrete bases. 9.
 - 10. Supports and anchorages.

1.03 DEFINITIONS

- Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred Α. spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- Concealed, Interior Installations: Concealed from view and protected from physical contact by D. building occupants. Examples include above ceilings and in chases.
- Concealed, Exterior Installations: Concealed from view and protected from weather conditions E. and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. Provide: To supply, furnish, install and connect, ready for safe and regular operation of the system or equipment.
- G. Install: To erect, mount and connect complete, with related accessories.
- H. Supply, Furnish: To purchase, procure, acquire and deliever complete, with related accessories.
- The following are industry abbreviations for plastic materials: I.
 - ABS: Acrylonitrile-butadiene-styrene plastic. 1.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- The following are industry abbreviations for rubber materials: J.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP COMMON WORK RESULTS FOR PLUMBING

220500 - 2

- 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
- 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - Transition fittings. 1.
 - Dielectric fittings. 2.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Α. Welding Code--Steel."
- Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Β. Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - Comply with provisions in ASME B31 Series, "Code for Pressure Piping." 1.
 - Certify that each welder has passed AWS gualification tests for welding processes 2. involved and that certification is current.
- Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical C. characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping. storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- Coordinate installation of required supporting devices and set sleeves in poured-in-place B. concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate all plumbing piping and equipment with all other trades, including HVAC, electrical, structural and Architectural ceiling elevations.

PART 1 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- Refer to individual Division 22 piping Sections for special joining materials not listed below. Α
- Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system В. contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges. b.
 - AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and 2. full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to E. ASTM B 813.
- Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty F. brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- Solvent Cements for Joining Plastic Piping: H.
 - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.04 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - Manufacturers: 1
 - Cascade Waterworks Mfg. Co. a.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - Smith-Blair, Inc. e.
 - f. Viking Johnson.
 - Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling. 2.
 - Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type 3. coupling.
 - Aboveground Pressure Piping: Pipe fitting. 4.

R23.00331.00

COMMON WORK RESULTS FOR PLUMBING

Greenwood Lake UFSD - 2023 CIP BING 220500 - 4

- B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Manufacturers:
 - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.05 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

Greenwood Lake Union Free School DistrictGreenwood Lake UFSD - 2023 CIPR23.00331.00COMMON WORK RESULTS FOR PLUMBING220500 - 5

2.07 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chromeplated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 1 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.

Greenwood Lake UFSD - 2023 CIP **Greenwood Lake Union Free School District** R23.00331.00 COMMON WORK RESULTS FOR PLUMBING

- Select system components with pressure rating equal to or greater than system operating K. pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following: 1. New Pipina:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - Insulated Piping: One-piece, stamped-steel type with spring clips. C.
 - Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castd. brass type with polished chrome-plated finish.
 - Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stampede. steel type.
 - Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel f. type with concealed hinge and set screw.
 - Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set g. screw or spring clips.
 - h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type. i.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, Ρ. and concrete floor and roof slabs.
 - Cut sleeves to length for mounting flush with both surfaces. 1.
 - Exception: Extend sleeves installed in floors of mechanical equipment areas or other a. wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space 3 between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150). a.
 - Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsumb. board partitions.
 - Except for underground wall penetrations, seal annular space between sleeve and pipe or 4. pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter. 1.
 - 2 Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

Greenwood Lake Union Free School DistrictGreenwood Lake UFSD - 2023 CIPR23.00331.00COMMON WORK RESULTS FOR PLUMBING220500 - 7

- 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - 2. Equal to Link-Seal by Garlock.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP COMMON WORK RESULTS FOR PLUMBING

- 2. PVC Nonpressure Piping: Join according to ASTM D 2855.
- Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139. J.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.03 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final 1. connection to each piece of equipment.
 - Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at 2. final connection to each piece of equipment.
 - Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of 3. dissimilar metals.
 - Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping 4. materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- Install equipment to allow maximum possible headroom unless specific mounting heights are Α not indicated.
- Install equipment level and plumb, parallel and perpendicular to other building systems and Β. components in exposed interior spaces, unless otherwise indicated.
- Install plumbing equipment to facilitate service, maintenance, and repair or replacement of C. components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.05 PAINTING

- Painting of plumbing systems, equipment, and components is specified in Division 09 Sections Α. "Interior Painting" and "Exterior Painting."
- Damage and Touchup: Repair marred and damaged factory-painted finishes with materials B. and procedures to match original factory finish.

3.06 CONCRETE BASES

- Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's A. written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, 2. install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Use 3000-psi (20.7-MPa, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

Greenwood Lake Union Free School DistrictGreenwood Lake UFSD - 2023 CIPR23.00331.00COMMON WORK RESULTS FOR PLUMBING220500 - 9

C. Field Welding: Comply with AWS D1.1.

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.09 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

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R23.00331.00

SECTION 220517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Pipe sleeves.
- B. Stack-Sleeve fittings.
- C. Sleeve-Seal Fittings
- D. Grout

1.03 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 099123 Interior Painting: Preparation and painting of interior piping systems.
- C. Section 220523 General-Duty Valves for Plumbing Piping.
- D. Section 220553 Identification for Plumbing Piping and Equipment: Piping identification.
- E. Section 220719 Plumbing Piping Insulation.

1.04 REFERENCE STANDARDS

- A. ASTM C592 Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- B. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. 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.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
 - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP

220517 - 2

Sleeves and Sleeve Seals for Plumbing Piping

1.07 DELIVERY, STORAGE, AND HANDLING

- Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place. A.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.08 WARRANTY

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

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- Manufacturers: Α
 - Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle. 1.
 - 2. Smith, Jay R. Mfg. Co..
 - 3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group...
 - Presealed Systems. 4.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.
- Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded C. steel collar; zinc coated.Pipe
- Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc D. coated, with plain ends.
- E. Passing Through Below Grade Exterior Walls:
 - Zinc coated or cast iron pipe. 1.
 - Provide watertight space with link rubber or modular seal between sleeve and pipe on 2. both pipe ends.
 - 3. Provide product equal to Link-Seal by Garlock.

F. Clearances:

- Provide allowance for insulated piping. 1.
- Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe 2. diameter.
- All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 3. in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 STACK-SLEEVE FITTINGS

- Α. Manufacturered, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrance flashing.
 - 1. Underdeck Clamp: Clamping rings with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

Manufacturered plastic, sleeve-type, water stop assemblies made for imbedding in concrete Α slab or wall. Unit has plastic or rubber water stop collar with center opening to match piping OD.

2.04 GROUT

- Standard: ASTM C 1107/C1107M Grade B, post-hardening and volume-adjusting, dry, A. hydraulic-cement grout.
- B. Characterictics: Non shrink; recommended for interior and exterior applications.

R23.00331.00

ree School DistrictGreenwood Lake UFSD - 2023 CIPSleeves and Sleeve Seals for Plumbing Piping220517 - 3

- C. Design Mix: 5000-psi, 28 day compressive strength.
- D. Packaging: Premix and factory packaged.

PART 3 EXECUTION

3.01 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.

3.02 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. Provide core through foundation wall sized as required by manufacturer of sleeve-seal system.
 - 4. Locate piping in center of sleeve or penetration.
 - 5. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 6. Tighten bolting for a water-tight seal.
 - 7. 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.

3.03 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.
- C. See Section 017419 Construction Waste Management and Disposal for additional requirements.

END OF SECTION 220517

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School DistrictGreenwood Lake UFSD - 2023 CIPGeneral-Duty Valves for Plumbing Piping220523 - 1

R23.00331.00

SECTION 220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

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

1.03 RELATED REQUIREMENTS

- A. Section 220553 Identification for Plumbing Piping and Equipment.
- B. Section 220719 Plumbing Piping Insulation.
- C. Section 221005 Plumbing Piping.

1.04 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.

1.05 REFERENCE STANDARDS

- A. ASME B1.20.1 Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.10 Face-to-Face and End-to-End Dimensions of Valves; 2017.
- C. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- D. ASME B31.9 Building Services Piping; 2020.
- E. ASTM A48/A48M Standard Specification for Gray Iron Castings; 2022.
- F. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
- G. ASTM A536 Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- H. ASTM B61 Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- I. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- J. AWWA C606 Grooved and Shouldered Joints; 2015.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP General-Duty Valves for Plumbing Piping

220523 - 2

- K. MSS SP-67 Butterfly Valves; 2017, with Errata.
- L. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- M. MSS SP-72 Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- N. MSS SP-78 Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- O. MSS SP-80 Bronze Gate, Globe, Angle, and Check Valves; 2019.
- P. MSS SP-110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata.
- Q. NSF 61 Drinking Water System Components Health Effects; 2019.
- R. NSF 372 Drinking Water System Components Lead Content; 2016.

1.06 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 Owner's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

- A. Manufacturer:
 - Obtain valves for each valve type from single manufacturer. 1.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - Minimize exposure of operable surfaces by setting plug and ball valves to open position. 1.
 - Protect valve parts exposed to piped medium against rust and corrosion. 2.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - Adjust globe, gate, and angle valves to the closed position to avoid clattering. 4.
 - 5. Secure check valves in either the closed position or open position.
 - Adjust butterfly valves to closed or partially closed position. 6.
- Use the following precautions during storage: B.
 - Maintain valve end protection and protect flanges and specialties from dirt. 1.
 - a. Provide temporary inlet and outlet caps.
 - Maintain caps in place until installation. b.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - Store valves indoors in dry environment. a.
 - Store valves off the ground in watertight enclosures when indoor storage is not an b. option.

1.09 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.

Greenwood Lake UFSD - 2023 CIP iping 220523 - 3

R23.00331.00

General-Duty Valves for Plumbing Piping

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. Conbraco Industries Inc.; Apollo Valves.
 - 2. Crane Co.; Crane Valve Group; Crane Valves.
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. NIBCO INC.
 - 6. Red-White Valve Corporation
 - 7. Watts Regulator Co.; a division of Watts Water Technologies. Inc.

2.02 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, ___
 - 2. Dead-End: Single-flange butterfly (lug) type.
 - 3. Throttling: Provide angle, ball, or butterfly.
 - 4. Swing Check (Pump Outlet):
 - a. 2 inch (50 mm, DN) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 inch (65 mm, DN) and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
- C. 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.
- D. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 inch (50 mm, DN) and Smaller: Threaded ends.
 - b. 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 2. Copper Tube:
 - a. 2 inch (50 mm, DN) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
- E. Low Pressure, Compressed Air Valves 150 psi (1035 kPa) or Less:
 - 1. 2 inch (50 mm, DN) and Smaller:
 - a. Bronze: Provide with solder-joint ends.
 - 2. 2-1/2 inch (65 mm, DN) and Larger:
 - a. Iron, 2-1/2 NPS (65 DN) to 4 NPS (100 DN): Provide with flanged or Welded ends.
- F. Domestic, Hot and Cold Water Valves:
 - 1. 2 inch (50 mm, DN) and Smaller:
 - a. Ball: Two piece, full port, brass with brass trim.
 - b. Bronze Swing Check: Class 125, bronze disc.
 - 2. 2-1/2 inch (65 mm, DN) and Larger:

R23.00331.00

School DistrictGreenwood Lake UFSD - 2023 CIPGeneral-Duty Valves for Plumbing Piping220523 - 4

- a. Iron Grooved-End Butterfly: 175 CWP.
- b. Iron Swing Check: Class 125, metal seats.

2.03 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:
- D. Insulated Piping Valves: With 2 inch (50 mm, DN) 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.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Solder Joint Connections: ASME B16.18.
 - 3. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
 - 1. Solder-joint Connections: ASME B16.18.
 - 2. 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. Source Limitations: Obtain each valve type from a single manufacturer.

2.04 BRONZE, BALL VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. WSP Rating: 150 psi (1035 kPa).
 - 3. WOG Rating: 600 psi (4140 kPa).
 - 4. Body: Forged bronze or dezincified-brass alloy.
 - 5. Ends Connections: Pipe thread or solder.
 - 6. Seats: PTFE.
 - 7. Stem: Stainless steel, blowout proof.
 - 8. Ball: Stainless steel, vented.
 - 9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Watts
 - c. Nibco Equal to 585HP-66-LF

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Wafer Style:

R23.00331.00

Greenwood Lake UFSD - 2023 CIP General-Duty Valves for Plumbing Piping

220523 - 5

- 1. Class 125, or Class 150 flanges.
- Comply with MSS SP-67, Type I. 2.
- Lug Style, Service Pressure Ratings: 3.
 - a. 150 psi (1034 kPa) for sizes 14 to 24 inch (350 to 600 mm, DN).
 - 250 psi (1725 kPa) for sizes 2 to 12 inch (50 to 300 mm, DN). b.
 - Vacuum down to 29.9 in-Hg (101.2 kPa). C.
- Body Material: ASTM A126, cast iron or ASTM A536, ductile iron. 4.
- Stem: One or two-piece stainless steel. 5.
- 6. Seat: EPDM.
- 7. Disc: Aluminum-bronze.
- Finish: Epoxy coated. 8.
- 9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.06 IRON, GROOVED-END BUTTERFLY VALVES

- A. CWP Rating: 175 psi (1200 kPa).
 - Comply with MSS SP-67, Type I. 1.
 - 2. Body: Coated ductile iron.
 - 3. Stem: Two-piece stainless steel.
 - 4. Disc: Coated ductile iron.
 - 5. Disc Seal: EPDM.

2.07 BRONZE, LIFT CHECK VALVES

- Α. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- Class 125: Β.
 - Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc 1. to Metal Seat.
 - 2. CWP Rating: 200 psi (1380 kPa).
 - Design: Vertical flow. 3.
 - Body: Comply with ASTM B61 or ASTM B62, bronze. 4.
 - End Connections: Threaded. 5.
 - Disc (Type 2): NBR. 6.

2.08 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Class 125, Threaded or Soldered End Connections:
 - WOG Rating: 200 psi (1380 kPa). 1.
 - 2. Body: Forged brass.
 - 3. Disc: Forged brass.
 - Hinge-Pin, Screw, and Cap: Forged brass. 4.

2.09 BRONZE, SWING CHECK VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - Copper alloys containing more than 15 percent zinc are not permitted. 2.
- B. Class 125:
 - Pressure and Temperature Rating: MSS SP-80, Type 3. 1.
 - Design: Y-pattern, horizontal or vertical flow. 2.

R23.00331.00

General-Duty Valves for Plumbing Piping

Greenwood Lake UFSD - 2023 CIP ag 220523 - 6

- 3. WOG Rating: 200 psi (1380 kPa).
- 4. Body: Bronze, ASTM B62.
- 5. End Connections: Threaded.
- 6. Disc: Bronze.

2.10 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 (1380 kPa).
 - 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.

2.11 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

3.01 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.

3.02 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.
 - 3. Orient plate-type into horizontal or vertical position, between flanges.

END OF SECTION 220523

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for Plumbing Piping and Equipment

220529 - 1

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

1.03 RELATED REQUIREMENTS

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

1.04 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- 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. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- E. MSS SP-58 Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.05 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 Architect 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.

1.06 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fitting Industry Inc.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for Plumbing Piping and Equipment

220529 - 2

1.07 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ACSE/SEI7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, systems contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.08 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- 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.

1.09 QUALITY ASSURANCE

A. Comply with applicable building code.

PART 2 PRODUCTS

2.01 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. 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.
- D. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

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

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for Plumbing Piping and 220529 - 3 Equipment

- 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 Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. 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.
- G. Secure fasteners according to manufacturer's recommended torque settings.
- H. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 BSD 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

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Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Identification for Plumbing Piping and Equipment

220553 - 1

SECTION 220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.

1.03 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Identification painting.

1.04 REFERENCE STANDARDS

- A. ASME A13.1 Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 Standard Specification for Laminated Thermosetting Materials; 2017.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

2.02 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 piece with up to three lines of text.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch (6 mm).
 - 3. Background Color: Black.

2.03 TAGS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00 Identification for Plumbing Piping and Equipment

220553 - 2

- 3. Seton Identification Products: www.seton.com/#sle.
- 4. Substitutions: See Section 016000 Product Requirements.
- B. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch (40 mm) in diameter.
- C. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Stencil Paint: As specified in Section 099123, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

- 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. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Identification Scheme, ASME A13.1:
 - 1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - 2. Secondary: Color scheme per fluid service.
 - a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive identification products.
- B. Prepare surfaces for stencil painting, see Section 099123.

3.02 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Apply stencil painted identification in compliance with Section 099123 requirements. Identify unit with assigned id-number and area being served using pipe marking rules.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

Greenwood Lake Union Free School District		Greenwood Lake UFSD - 2023 CIP
R23.00331.00	Identification for Plumbing Piping and Equipment	220553 - 3

G. Install labels and/or tags on all pipes as follows:

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R23.00331.00

Plumbing Piping Insulation

Greenwood Lake UFSD - 2023 CIP 220719 - 1

SECTION 220719 PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jackets and accessories.
- D. Supplies and drains for hand
- E. Section includes insulating the following pipe systems
 - 1. Domestic Cold Water Piping
 - 2. Domestic Hot Water Piping
 - 3. Domestic recirculating hot water piping
 - 4. Roof Drains and Rainwater leaders

1.02 RELATED REQUIREMENTS

- A. Section 099123 Interior Painting: Painting insulation jacket.
- B. Section 221005 Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- B. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- C. ASTM C534/C534M Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020a.
- D. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation; 2019.
- E. ASTM C552 Standard Specification for Cellular Glass Thermal Insulation; 2017, with Editorial Revision (2018).
- F. ASTM C585 Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).
- G. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- H. ASTM D2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- I. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- J. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- K. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 DELIVERY, STORAGE, AND HANDLING

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

R23.00331.00

Plumbing Piping Insulation

Greenwood Lake UFSD - 2023 CIP 220719 - 2

- B. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- C. Maintain ambient conditions required by manufacturers of each product.
- D. Maintain temperature before, during, and after installation for minimum of 24 hours.

1.05 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

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

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - 1. K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 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 perminches (0.029 ng/Pa s m).

2.03 CELLULAR GLASS

- A. Insulation: ASTM C552, Type II, Grade 6.
 - 1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
 - 2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
 - 3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/Pa s m) maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.

2.04 JACKETS

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
R23.00331.00

Plumbing Piping Insulation

Greenwood Lake UFSD - 2023 CIP 220719 - 3

- c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
- d. Thickness: 10 mil (0.25 mm).
- e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 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.
 - 1. Provide PVC jacket on all exposed piping up to 7' above finished floor (i.e. all piping at domestic hot water system and exposed vertical storm leaders).
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
 - 1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.
- F. 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.
- G. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- H. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.

3.03 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

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

B. Domestic Hot and Recirculated Hot Water (105-140 F):

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

R23.00331.00

Plumbing Piping Insulation

Greenwood Lake UFSD - 2023 CIP 220719 - 4

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

C. Stormwater and Overflow:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - b. Manufactured system with PVC jacket equal to Truebro. Refer also to fixture specification.

F. Sanitary Waste Piping Where Heat Tracing Is Installed:

- All Pipe Sizes: Insulation shall be the following:
- a. Cellular Glass: 2 inches thick.

3.04 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the fieldapplied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
- D. Piping, Exposed:

1.

1. PVC: 20 mils thick.

END OF SECTION 220719

Greenwood Lake Union Free School District R23.00331.00 Plumbing Piping Greenwood Lake UFSD - 2023 CIP 221005 - 1

SECTION 221005 PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet (1500 mm) of building.
- B. Domestic water piping, buried within 5 feet (1500 mm) of building.
- C. Domestic water piping, above grade.
- D. Storm drainage piping, buried within 5 feet (1500 mm) of building.
 - 1. Sanitary sewer and sanitary vent
 - 2. Pipe flanges, unions, and couplings.

1.02 RELATED REQUIREMENTS

- A. Section 083100 Access Doors and Panels.
- B. Section 099113 Exterior Painting.
- C. Section 220516 Expansion Fittings and Loops for Plumbing Piping.
- D. Section 220553 Identification for Plumbing Piping and Equipment.
- E. Section 312316 Excavation.
- F. Section 312323 Fill.

1.03 REFERENCE STANDARDS

- A. ASME B16.3 Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- B. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- D. ASME B16.23 Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- E. ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- F. ASME B31.1 Power Piping; 2020.
- G. ASME B31.9 Building Services Piping; 2020.
- H. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- I. ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- J. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- K. ASTM B32 Standard Specification for Solder Metal; 2020.
- L. ASTM B42 Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- M. ASTM B88 Standard Specification for Seamless Copper Water Tube; 2020.
- N. ASTM B88M Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O. ASTM B306 Standard Specification for Copper Drainage Tube (DWV); 2020.
- P. ASTM B813 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

- Q. ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- R. ASTM C564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- S. ASTM C1277 Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- T. ASTM D2513 Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- U. ASTM D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- V. ASTM D2846/D2846M Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.
- W. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- X. ASTM F437 Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2021.
- Y. ASTM F438 Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2023.
- Z. ASTM F439 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.
- AA. ASTM F441/F441M Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.
- BB. ASTM F442/F442M Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2023.
- CC. ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.
- DD. AWWA C105/A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- EE. AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings; 2021.
- FF. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- GG. AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- HH. AWWA C651 Disinfecting Water Mains; 2014, with Addendum (2020).
- II. CISPI 301 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- JJ. 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; 2020.
- KK. NSF 61 Drinking Water System Components Health Effects; 2019.
- LL. NSF 372 Drinking Water System Components Lead Content; 2016.
- MM. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

R23.00331.00

Plumbing Piping

Greenwood Lake UFSD - 2023 CIP 221005 - 3

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 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.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.
- C. All Cast Iron Soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institue (CISPI) and listed by NSF International.
 - 1. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer or manufacturer's register trademark

2.02 SANITARY WASTE PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

2.03 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

2.04 SANITARY SEWER AND SANITARY VENT PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. High Performance Coated Cast Iron Pipe: CISPI 301, hubless, service weight.
- C. Equal to Charlotte Edge or
 - 1. Pipe and Fittings: ASTM A 888 or CISPI 301
 - 2. Pipe Coating on ID and OD, which shall meet a minium salt spray testing.
 - 3. Fittings: Cast iron.

R23.00331.00

Plumbing Piping

Greenwood Lake UFSD - 2023 CIP 221005 - 4

- 4. Gaskets: ASTM 564 rubber
- 5. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- D. Copper Tube: ASTM B306, DWV.
 - 1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, sovent.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.05 CHEMICAL-RESISTANT SANITARY WASTE PIPING

- A. CPVC Pipe: ASTM D2846/D2846M, ASTM F441/F441M, ASTM F2618, or ASTM F442/F442M.
 - 1. Manufacturers:
 - a. IPEX USA, LLC; Xirtec CPVC Schedule 40: www.ipexna.com/#sle.
 - b. Charlotte Pipe ChemDrain.
 - 2. Pipe shall be manufactured from CPVC type IV Grade 1 compounds with minimum cell class of 23447.
 - 3. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 4. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
 - a. Use one step solvent cement specially formulated for CPVC Chemical Waste Application that has a VOC content of ~500 g/L or less.

2.06 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: AWWA C110/A21.10, ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket with 3/4-inch (19 mm) diameter rods.
- B. Copper Pipe: ASTM B42, hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2.07 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch (19 mm) diameter rods.

2.08 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.

2.09 STORM DRAINAGE PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

2.10 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

Plumbing Piping

Greenwood Lake UFSD - 2023 CIP 221005 - 5

2.11 STORM DRAINAGE PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.12 NATURAL GAS PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

- A. Polyethylene Pipe: ASTM D2513, SDR 11.
 - 1. Fittings: ASTM D2683 or ASTM D2513 socket type.
 - 2. Joints: Fusion welded.

2.13 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: ASME B31.1, welded.
 - 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.14 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.
 - 3. Paint all exposed exterior natural gas piping. Confirm color with Architect. Grey, Yellow or as otherwise prescribed.

2.15 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 - 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. No-Hub Couplings:
 - 1. Testing: In accordance with ASTM C1277 and CISPI 310.
 - 2. NSF Certification
 - 3. Gasket Material: Neoprene complying with ASTM C564.
 - 4. Band Material: Stainless steel.
 - 5. Eyelet Material: Stainless steel.
 - 6. Manufacturers:
 - a. MIFAB, Inc; MI-QHUB: www.mifab.com/#sle.
 - b. Charlotte Pipe and Foundry
 - c. Ideal Tridon

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 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.

R23.00331.00

Plumbing Piping

Greenwood Lake UFSD - 2023 CIP 221005 - 6

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.
 - 1. Coordinate size and location of access doors with Section 083100.
- H. Establish elevations of buried piping outside the building to ensure not less than 5 ft (_____ m) of cover for pipes that require freeze protection.
- I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly; see Section
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
 1. See Section 099113 for painting of exterior plumbing systems and components.
- K. Excavate in accordance with Section 312316.
- L. Backfill in accordance with Section 312323.
- M. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- 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. Sleeve pipes passing through partitions, walls, and floors.
- Q. 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. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm, DN).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- R. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

Plumbing Piping

- 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- 7. Provide copper plated hangers and supports for copper piping.
- 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- S. Pipe 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 watertight seal.
 - 6. Install in accordance with manufacturer's recommendations.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- D. Provide spring-loaded check valves on discharge of water pumps.

3.05 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Test Sanitary waste and vent piping according to procedures of AHJ or in absense of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit seperate report for each test.
 - 2. Leave piping uncovered and unconcealed new, altered, extended or replaced waste and vent piping until it has been tested, inspected and approved.
 - 3. Rough-in Plumbing test Procedure:
 - a. Close openings in piping system and fill with water to point of overflow, but not less then 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
- C. Domestic Water Systems:
 - 1. Perform hydrostatic testing for leakage prior to system disinfection.
 - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
 - 3. General:

Plumbing Piping

- a. Fill the system with water and raise static head to 10 psi (345 kPa) above service pressure. Minimum static head of 50 to 150 psi (345 to 1,034 kPa). As an exception, certain codes allow a maximum static pressure of 80 psi (551.6 kPa).
- D. Gas Distribution Systems:
 - 1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
 - 2. General Systems:
 - a. Inject a minimum of 10 psi (68.9 kPa) of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
 - b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound (0.45 kg).
 - 3. Welded Pipes or Systems with Service Pressures Above 14 in-wc (3.48 kPa):
 - a. Inject a minimum of 60 psi (413.7 kPa) of compressed air into the piping system for a duration of 30 minutes and verify with a gauge that no perceptible pressure drop is measured.
 - b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound (0.45 kg) with 1 psi (6.9 kPa) increments.
- E. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.06 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 disinfectant residual at minimum 15 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 in accordance with AWWA C651.

3.07 DISINFECTION OF DOMESTIC WATER PIPING - NYS DOH

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of the existing piping that have been altered, extended, or repaired, before putting back into use.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours. OR

Greenwood Lake Union Free School District	
R23.00331.00	Plumbing Piping

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine (above normal potable water limites) is in water coming from system after the standing time.
- d. Repeat procedures if biologival examination shows contaimination.
- e. Submit water sampes in sterile bottles to NYS Department of Health approved lab with results sent to the DOH and to the architect/engineer of record as project submittal.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water sample approval from NYS Department of Health approved lab.
- C. Where new fixture have been added to nYS K-12 school buildings, test samples shall be taken at all new fixtures in accordance with SED testing protocol for Lead. Submit test results to Arch/Engineer./District.

3.08 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. 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. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 - 1. 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.

END OF SECTION 221005

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R23.00331.00

Greenwood Lake UFSD - 2023 CIP 221006 - 1

SECTION 221006 PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains. Roof and Floor
- B. Cleanouts.
- C. Hose bibbs.
- D. Water hammer arrestors.
- E. Mixing valves.

1.02 REFERENCE STANDARDS

- A. ASME A112.6.3 Floor Drains; 2022.
- B. ASME A112.6.4 Roof, Deck, and Balcony Drains; 2022.
- C. NSF 61 Drinking Water System Components Health Effects; 2019.
- D. NSF 372 Drinking Water System Components Lead Content; 2016.
- E. PDI-WH 201 Water Hammer Arresters; 2017.

1.03 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- F. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 Product Requirements for additional provisions.
 - 2. Extra Loose Keys for Outside Hose Bibbs: One.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

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

2.02 DRAINS

A. Roof Drains (RD-1) Primary General Purpose:

R23.00331.00

Plumbing Piping Specialties

Greenwood Lake UFSD - 2023 CIP 221006 - 2

- 1. Assembly: ASME A112.6.4.
- 2. Body: Lacquered cast iron with sump.
- 3. Strainer: Removable cast aluminum dome with vandal proof screws.
- 4. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable extension sleeve for roof insulation.
- 5. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle. Equal to Figure 1015 Series
 - b. Josam
 - c. MIFAB, Inc: www.mifab.com/#sle.
 - d. Zurn Industries, LLC; Z100F: www.zurn.com/#sle.
 - e. Watts
- B. Roof Drains (RD-2) Secondary Overflow (to daylight):
 - 1. Assembly: ASME A112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir. 2" high
 - f. Adjustable extension sleeve for roof insulation.
 - 4. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle. Equal to figure 1045
 - b. Josam
 - c. MIFAB, Inc: www.mifab.com/#sle.
 - d. Zurn Industries, LLC; Z100F: www.zurn.com/#sle.
 - e. Watts
- C. Downspout Nozzles For Secondary RD daylight termination (DN-1):
 - 1. Stainless Steel with hinged cover and perforated flap
 - 2. Size to match associated RD-2
 - 3. Equal to JR Smith Figure 1775
- D. Floor Drains:
 - 1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. Josam
 - c. MIFAB, Inc: www.mifab.com/#sle.
 - d. Zurn Industries, LLC: www.zurn.com/#sle.
 - e. Watts
- E. Floor Drain Finished area/Toilet room/Shower (FD-1):

R23.00331.00

Plumbing Piping Specialties

Greenwood Lake UFSD - 2023 CIP 221006 - 3

- 1. 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.
- 2. Equal to JR Smith Figure 2051

2.03 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - 2. Josam Company: www.josam.com/#sle.
 - 3. MIFAB, Inc; C1100-R: www.mifab.com/#sle.
 - 4. Zurn Industries, LLC: www.zurn.com/#sle.
 - 5. Watts
- B. Cleanouts at Interior Finished Floor Areas FCO:
 - 1. Galvanized cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored Nickel Bronze cover in service areas and hard surface finished floors and round gasketed depressed cover to accept floor finish in carpeted floor areas.
- C. Cleanouts at Interior Finished Wall Areas WCO:
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- D. Cleanouts at Interior Unfinished Accessible Areas CO: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 WATER HAMMER ARRESTORS

- A. 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 (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install floor drains at low point in floor. Corrdinate final "flush to finished floor" drain cover elevation with GC flooring installer. If entire floor is not pitched to floor drain, create 2' diameter low point at drain, pitched ~1/8"/foot.

END OF SECTION 221006

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R23.00331.00

Plumbing Fixtures

Greenwood Lake UFSD - 2023 CIP 224000 - 1

SECTION 224000 PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush valve water closets.
- B. Bidets.
- C. Wall-hung, solid surface, multistation lavatory units.
- D. Sinks.
- E. Under-lavatory pipe supply covers.

1.02 RELATED REQUIREMENTS

- A. Section 064100 Architectural Wood Casework: Counters for sinks and lavatories.
- B. Section 079200 Joint Sealants: Sealing joints between fixtures and walls and floors.
- C. Section 221005 Plumbing Piping.
- D. Section 221006 Plumbing Piping Specialties.
- E. Section 223000 Plumbing Equipment.
- F. Section 260583 Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.6.1M Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- C. ASME A112.18.1 Plumbing Supply Fittings; 2018, with Errata.
- D. ASME A112.18.9 Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- E. ASME A112.19.1 Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.
- F. ASME A112.19.2 Ceramic Plumbing Fixtures; 2018, with Errata.
- G. ASME A112.19.4M Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (Reaffirmed 2009).
- H. ASME A112.19.5 Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- I. ASME A112.19.15 Bathtubs/Whirlpool Bathtubs with Pressure Sealed Doors; 2012 (Reaffirmed 2022).
- J. ASSE 1014 Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2020.
- K. ASSE 1070 Performance Requirements for Water Temperature Limiting Devices; 2020.
- L. ASTM C1822 Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- M. ICC A117.1 Accessible and Usable Buildings and Facilities; 2017.
- N. NSF 61 Drinking Water System Components Health Effects; 2019.
- O. NSF 372 Drinking Water System Components Lead Content; 2016.

P. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 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. Sustainable Design Documentation: Submit appropriate evidence that materials used in potable water systems comply with the specified requirements.
- E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 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.

1.07 WARRANTY

- A. See Section 017800 Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 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, and showerheads.

2.02 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.

2.03 PLUMBING FIXTURES

- A. See Plumbing Plans for Plumbing Fixture Schedule
 - 1. Provide Plumbing Fixtures and all accessories as indicated on the plumbing fixture schedule on the drawings. Acceptable manufacturer are indicated below.
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Delany Products: www.delanyproducts.com/#sle.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP 224000 - 3

- **Plumbing Fixtures**
- c. DXV by American Standard, Inc: www.dxv.com/#sle.
- d. Sloan Valve Company: www.sloanvalve.com/#sle.
- e. Kohler Company: www.kohler.com/#sle.
- f. Viega LLC: www.viega.us/#sle.
- g. Zurn Industries, Inc: www.zurn.com/#sle.
- h. _____
- i. Substitutions: See Section 016000 Product Requirements.

2.04 FLUSH VALVE WATER CLOSETS (WC-1)

- A. Water Closets: Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action.
 - 1. Bowl: ASME A112.19.2; 15 Inches high with elongated rim.
 - 2. Flush Valve: Exposed (top spud).
 - 3. Flush Operation: Sensor operated.
 - 4. Handle Height: 44 inches (1117 mm) or less.
 - 5. Trapway Outlet: 4 inch (100 mm, DN).
 - 6. Color: White.
- B. Flush Valves:
- C. See Plumbing Schedule for Model Information
- D. Toilet Seats:
 - 1. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.
- E. See Plumbing Schedule for Model Information
- F. Water Closet Carriers:
 - 1. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.05 FLUSH VALVE WATER CLOSETS - ADA (WC-2)

- A. Water Closets: Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action.
 - 1. Bowl: ASME A112.19.2; 16.5 inches high with elongated rim.
 - 2. Flush Valve: Exposed (top spud).
 - 3. Flush Operation: Sensor operated.
 - 4. Handle Height: 44 inches (1117 mm) or less.
 - 5. Supply Size: 1-1/2 inches (38 mm).
 - 6. Outlet Size: 4 inches (_____ mm).
 - 7. Color: White.
- B. See Plumbing Schedule for Model Information
- C. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Sensor-Operated Type: Solenoid or motor-driven operator, low voltage hard-wired, infrared sensor with mechanical over-ride or over-ride push button.
 - 2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
- D. See Plumbing Schedule for Model Information
- E. Seats:
 - 1. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

R23.00331.00

- 2. See Plumbing Schedule for Model Information
- F. Water Closet 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.
 - d. Substitutions: See Section 016000 Product Requirements.
 - 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.06 LAVATORIES - ADA (LAV-1)

- A. Vitreous China Under-Mount Basin: ASME A112.19.2; vitreous china under-mount lavatory, front overflow, mounting kit and template by manufacturer.
- B. See Plumbing Schedule for Model Information
- C. Sensor Operated Faucet: Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
 - 1. Spout Style: Standard.
 - 2. Power Supply: Battery, easily replaceable, alkaline or lithium, minimum 200,000 cycles.
 - 3. Low battery indicator warning light at 30 days remaining life and continuous light a 2 weeks.
- D. Power Supply: Per manufacturer's requirements.
 - 1. Cord and plug.
 - 2. For 6V or 24V applications, provide transformer.
- E. Mixing Valve: Internal, automatic.
- F. Water Supply: 3/8 inch (9 mm) compression connections.
- G. Aerator: Vandal resistant, 0.5 GPM (1.89 LPM), laminar flow device.
- H. Sensor range: Factory set at a minimum of 3 inch (76 mm) adjustable up to 24 inch (610 mm).
- I. Finish: Polished chrome.
- J. Accessory: 4 inch (102 mm) deck plate.
- K. Lead Content: Extra low; maximum 0.25 percent by weighed average.
- L. Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.
- M. See Plumbing Schedule for Model Information
- N. Provide lavatory with combination stop and strainer.
- O. Accessories:
- P. Chrome plated 17 gauge, 0.0538 inch (1.37 mm) brass P-trap with clean-out plug and arm with escutcheon.
- Q. Offset waste with perforated open strainer.
- R. Wheel handle stops.
- S. Flexible supplies.
- T. Carrier:

R23.00331.00

Plumbing Fixtures

Greenwood Lake UFSD - 2023 CIP 224000 - 5

1. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

2.07 UNDER-LAVATORY PIPE SUPPLY COVERS

- A. Manufacturers:
 - 1. Plumberex Specialty Products, Inc; ____: www.plumberex.com/#sle.
 - 2. Truebro
 - 3. Oatey
 - 4. ____
 - 5. Substitutions: See Section 016000 Product Requirements.
- B. General:
 - 1. Insulate exposed drainage piping, as well as, hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
 - 2. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - b. Comply with ICC A117.1.
 - 3. Color: High gloss white.
 - 4. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces. No cable ties allowed.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

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

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

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

3.05 ADJUSTING

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

R23.00331.00

Plumbing Fixtures

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.
- B. See Section 017419 Construction Waste Management and Disposal for additional requirements.

3.07 PROTECTION

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

END OF SECTION 224000

R23.00331.00

General Provisions for Mechanical Work

Greenwood Lake UFSD - 2023 CIP k 230000 - 1

SECTION 230000 GENERAL PROVISIONS FOR MECHANICAL WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of this Section apply to work in every Section of Division 23 equally as if incorporated therein.

1.02 WORK INCLUDED

A. Work included in Division 23 - Mechanical: Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for Mechanical Work covered by all sections within this Division.

1.03 SCOPE

- A. Division of the Specification into sections is for the purpose of simplification alone. Responsibility for the work of various trades shall rest with the Contractor. Various sections of this Division are related to each other as well as the mechanical drawings. Examine all drawings and read all applicable parts of the project manual in order to ensure complete execution of all work in this Division, coordinating where required with other trades in order to avoid conflicts.
- B. These specifications and accompanying drawings are intended to cover the furnishing of all labor, materials, equipment and services necessary for the complete installation and acceptable performance of the mechanical systems. Small items of material, equipment and appurtenances not mentioned in detail or shown on the drawings, but necessary for complete and operating systems shall be provided by this contractor without additional charge to the Owner and shall be included under this contract.
- C. In general, specifications establish the quality of material, equipment and workmanship. The contract documents are intended to secure for the Owner, a first-class installation in every respect. Labor shall be performed by skilled mechanics, and the entire facility, when delivered to the Owner, shall be ready for satisfactory and efficient operation.
- D. The Contractor shall carefully examine the drawings and specifications before accepting the contract. He shall call attention to any changes or additions which, in his opinion, are necessary to make possible the fulfillment of any guarantee called for by these specifications; failing which, it shall be deemed that he has accepted full responsibility for all such guarantees.
- E. The contractor shall put his work in place as fast as is reasonably possible. He shall, at all times, keep a competent foreman in charge of the work, to make decisions necessary for the diligent advancement of the work. The Contractor shall facilitate the inspection of the work by the Owner's Representative.
- F. The Contractor shall coordinate all work in the building in order to facilitate intelligent execution of the work. He shall also remove any rubbish as expeditiously as possible.

R23.00331.00

- G. Materials or products specified herein and/or indicated on the drawings by trade's names, manufacturer's names, model number or catalog numbers establish the quality of materials or products to be furnished. Model numbers are to be confirmed by the manufacturer to provide required capacities and material to meet the specifications and design intent. In no instance shall an obsolete, incomplete or inaccurate trade name, manufacturer name, model number or catalog number indicated on the drawings, result in additional charges to the owner.
- H. Points of connection or continuation of work under this contract are so marked on drawings or herein specified. In case of any doubt as to the required exact location of such points, the Owner's Representative shall decide and direct.
- I. The plumbing contractor shall provide water services to within two (2) feet of HVAC equipment requiring same, and shall terminate service with a shutoff valve. The mechanical contractor shall make the final connection to the equipment.

1.04 REFERENCE STANDARDS, CODES AND REGULATIONS

- A. Requirements of Regulatory Agencies:
 - Nothing contained in these specifications or shown on the drawings shall be construed to conflict with any State or local laws, ordinances, rules and regulations, the UL and NFPA regulations. The Contractor shall make all changes required by the enforcing authorities. Where alterations to and / or deviations from the Contract Documents are required by the authorities having jurisdiction, report the requirements to the Engineer and secure acceptance before work is started. All such changes shall be made in a manner acceptable to the Engineer and shall be made without cost to the Owner.
 - 2. When drawings or specifications exceed requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement. All work shall be done in full conformity with the requirements of all authorities having jurisdiction. Installation shall be made in compliance with all applicable regulations, and utility company rules, all of which shall be considered a part of this specification and shall take precedence in the order of listing.
 - 3. It is not the intent of drawings or specifications to repeat requirements of codes except where necessary for completeness in individual sections.
- B. Published specifications, standards, tests or recommended method of trade, industry or governmental organizations as listed below apply to all work in this Division, in addition to other standards which may be specified in individual sections:
 - 1. Associated Air Balance Council
 - 2. Air Diffuser Balance Council
 - 3. Air Moving and Conditioning Association
 - 4. American Gas Association
 - 5. American National Standards Institute
 - 6. Air Conditioning and Refrigeration Institute
 - 7. American Society of Heating, Refrigeration and Air Conditioning Engineers
 - 8. American Society of Mechanical Engineers
 - 9. American Society for Testing and Materials
 - 10. Cast Iron Soil Pipe Institute
 - 11. ETL Testing Laboratories
 - 12. Factory Mutual Engineering and Research Corporation
 - 13. National Standard Plumbing Code
 - 14. National Electrical Manufacturer's Association

R23.00331.00

General Provisions for Mechanical Work

Greenwood Lake UFSD - 2023 CIP k 230000 - 3

- 15. National Fire Protection Association
- 16. National Board of Fire Underwriters
- 17. National Electric Code
- 18. Occupational Safety and Health Administration
- 19. Plumbing Drainage Institute
- 20. Sheet Metal & Air Conditioning Contractors National Association
- 21. Underwriters Laboratories, Inc.
- C. Furnish and file with the proper authorities, all drawings required by them in connection with the work. Contractor shall secure and obtain all approvals, permits, licenses and inspections and pay all legal and proper fees and charges in this connection, before commencing work in order to avoid delays during construction. He shall deliver the official records of the granting of the permits, etc., to the Owner's Representative.

1.05 QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards listed in Article 1.4 of this section with all applicable national, state and local codes.
- D. All items of a given type shall be the product of same manufacturer.

1.06 DESCRIPTION OF BID DOCUMENTS

- A. Specifications:
 - 1. Specifications, in general, describe quality and character of materials and equipment.
 - 2. Specifications are of simplified form and include incomplete sentences.
 - 3. Words or phrases such as "The Contractor shall", "shall be", "furnish", "provide", "a", "an", "the", and "all" may have been omitted for brevity.
- B. Drawings: Mechanical drawings under this contract are made a part of these specifications. Deviations from these specifications as noted below must have the approval of the Engineer or Construction Manager without an increase in contract price.
 - 1. The drawings shall be considered as being diagrammatic and for bidding purposes only. Intention is to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement. The attention of the contractor is called to the fact that while these drawings are generally to scale and are made as accurately as the scale will permit, all critical dimensions shall be determined in the field. They are not to be considered as erection drawings.
 - 2. The drawings do not indicate every fitting, elbow, offset, valve, etc. which is required to complete the job. Contractor shall prepare field erection drawings as required for the use of his mechanics to insure proper installation.
 - 3. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions.
 - 4. Before proceeding with work check and verify all dimensions in field.
 - 5. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
 - 6. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

R23.00331.00

- 7. For exact locations of building elements, refer to dimensional Architectural/Structural drawings.
- C. Description of systems: Provide all materials to provide functioning systems in compliance with performance requirements specified, and any modifications resulting from reviewed shop drawings and field coordinated drawings.
 - 1. Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination drawings.
- D. Do not use equipment exceeding dimensions indicated or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.
- If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect for E. his interpretation and decision as early as possible, including during bidding period. Do not proceed with work without Engineer's decision. 1.

1.07 EQUIPMENT MANUFACTURERS

- The first named manufacturer is used as the basis of design. Other named manufacturers are Α. identified as equivalent manufacturers, not equivalent products. Naming other manufacturers does not necessarily imply conformance of any specific product with the written specifications.
- The contractor is required to verify that equipment and material to be used on the project meets Β. the requirements of the specifications and will physically fit the available space, clearance and service requirements of the particular piece of equipment and include all pertinent information when he submits material for acceptance. Contractor shall also be responsible for and bear the cost of any modifications to openings available or anticipated as being available for rigging equipment to its final installation place. This shall include openings in exterior envelope, walls and roofs, interior walls, corridors, passage ways or door openings. Any on site dismantling and any reassembly of equipment made necessary by impediment to the rigging of said equipment shall be the sole responsibility of the contractor.
- C. Contract document indicates power and physical requirements based on the equipment manufacturer's data as first named. If equipment requiring more system capacity is furnished, the contractor shall be responsible for the cost associated with modifying the design and installation of associated services, including any redesign costs associated with the engineer's review.

1.08 DEFINITIONS

- Α. "Provide": To supply, furnish, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted.
- "Install": To erect, mount and connect complete with related accessories. Β.
- C. "Supply", "Furnish": To purchase, procure, acquire and deliver complete with related accessories.
- D. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.
- E. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.
- F. "Wiring": Raceway, fittings, wire, boxes and related items.
- G. "Concealed": Items referred to as hidden from normal sight, embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures.

- H. "Exposed": Not installed underground or "concealed" as defined above.
- I. "Indicated", "Shown", or "Noted": As indicated, shown or noted on drawings or specifications.
- J. "Directed": Directed by Engineer.
- K. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified product.
- L. "Reviewed", "Satisfactory", or "Directed": As reviewed, satisfactory, or directed by or to Engineer.
- M. "Motor Controllers": Manual or magnetic starters (with or without switches), individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.
- N. "Control or Actuating Devices": Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.
- O. "Remove": Dismantle, demolish and take away from the site and dispose of in accordance with all applicable rules and regulations or, should the Owner so require, deliver to a location as designated by the Owner for the use of the Owner, at no additional cons to the Owner.
- P. "Replace": Remove existing and provide an equivalent product or material as specified.
- Q. "Extract (and Reinstall) ": Carefully disassemble, dismantle existing, save or store where directed by the Owner, in such a manner as to preserve the existing condition and reinstall as indicated on the drawings or as described in the specifications.
- R. Where any device or piece of equipment is referred to in the singular number, such reference shall be deemed to apply to as many devices as are required to complete the installation.

1.09 JOB CONDITIONS

- A. This contractor shall investigate all conditions affecting his work and shall provide such offsets, fittings, valves, sheet metal work, etc., as may be required to meet conditions at the building.
- B. The contractor shall verify all measurements at the building site and shall be responsible for the correctness of same before ordering materials or before starting work of any Section.
 - 1. Report to Architect, in writing, conditions which will prevent proper provision of this work.
 - 2. Beginning work of any Section without reporting unsuitable conditions to Architect constitutes acceptance of conditions by Contractor.
 - 3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.
- C. Piping and ductwork shall be concealed or run behind furring in finished spaces unless otherwise noted to be run exposed.
- D. Horizontal piping and ductwork not run below slabs on grade shall be run as close as possible to underside of roof or floor slab above and parallel to building lines. Maintain maximum headroom in all areas.
- E. Determine possible interference between trades before the work is fabricated or installed. The contractor must coordinate his work to insure that erection will proceed without such interference. Coordination is of paramount importance and no request for additional payment will be considered where such request is based upon interference between trades.
- F. Connections to Existing Work:
 - 1. Install new work and connect to existing work with minimum of interference to existing facilities.
 - 2. Temporary shutdowns of existing services:

R23.00331.00

- 3. At no additional charges
 - a. At times not to interfere with normal operation of existing facilities.
 - b. Only with written consent of Owner.
- 4. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
- 5. Restore existing disturbed work to original condition.
- G. Removal, extraction and relocation of existing work.
 - 1. The work includes demolition or removal of all construction indicated or specified. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the site. Rubbish and debris shall be removed from the site daily unless otherwise directed so as to not allow accumulation inside or outside the building. Materials that cannot be removed daily shall be stored in areas specified by the Owner.
 - 2. Title to all materials and equipment to be demolished, excepting Owner salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Owner will not be responsible for the condition, loss or damage to such property after notice to proceed.
 - 3. The Owner reserves the "Right of First Refusal" on all material for salvage. Material for salvage shall be stored as approved by the Owner. Salvage materials shall be removed from the site before completion of the Contract. Material for salvage shall not be sold on the site.
 - 4. Property of the Owner: Salvaged items remaining the property of the Owner shall be removed in a manner to prevent damage and packed or crated to protect the items from damage while in storage or during shipment and relocated by the contractor at no cost, to the Owners designated storage facility on the site. Containers shall be properly identified as to contents.
 - 5. Damaged Items: Items damaged during removal or storage shall be repaired or replaced to match existing.
 - 6. Disconnect, remove or relocate material, equipment, plumbing fixtures, piping and other work noted and required by removal or changes in existing conditions.
 - 7. Where existing pipes, conduits and/or ducts which are to remain prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits, and/or ducts.
 - 8. Provide new material and equipment required for relocated equipment.
 - 9. Plug or cap active piping or ductwork behind or below finish.
 - 10. Do not leave long dead-end branches.
 - a. Cap or plug as close as possible to active line.
 - 11. Remove unused piping, ductwork and equipment.
 - 12. Dispose of unusable piping, ductwork and material.

1.10 CLEARANCE FROM ELECTRICAL EQUIPMENT

- A. Piping or ductwork:
 - 1. Prohibited, except as noted, in:
 - a. Electric rooms and closets.
 - b. Telephone rooms and closets.
 - c. Elevator machine rooms.
 - d. Electric switchboard room.
 - 2. Prohibited, except as noted, over or within 5 ft. of:

R23.00331.00

General Provisions for Mechanical Work

Greenwood Lake UFSD - 2023 CIP k 230000 - 7

- a. Transformers.
- b. Substations.
- c. Switchboards.
- d. Motor control centers.
- e. Standby power plant.
- f. Bus ducts.
- g. Electrical panels.
- 3. Drip pans under piping:
 - a. Only where unavoidable and approved.
 - b. 18 gauge galvanized steel.
 - 1) With bituminous paint coating.
 - c. Reinforced and supported.
 - d. Watertight.
 - e. With 1-1/4 inch drain outlet piped to floor drain or service sink.

1.11 TEMPORARY FACILITIES

A. Temporary facilities are not included within this Section.

1.12 SPECIAL TOOLS

- A. Furnish to Owner at completion of work:
 - 1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of the Division.
 - 2. "Special tools": those not normally found in possession of mechanics or maintenance personnel.
 - 3. One pressure grease gun for each type of grease required.
 - a. With adapters to fit all lubricating fittings on equipment.
 - b. Include lubricant for lubricated plug valves.

1.13 PRODUCT DELIVERY, HANDING AND STORAGE

- A. Provide adequate and secure storage facilities for materials and equipment during the progress of the work.
- B. Contractor shall be responsible for the condition of all materials and equipment employed in the mechanical installation until final acceptance by the Owner. Protect same from any cause whatsoever.
- C. Where necessary, ship in crated sections of size to permit passing through available space.
- D. Ship equipment in original packages, to prevent damaging or entrance of foreign matter.
- E. Handle and ship in accordance with manufacturer's recommendations.
- F. Provide protective coverings during construction.
- G. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by Engineer.
- H. Tag all items with weatherproof tag, identifying equipment by name and purchase order number.
- I. Include packing and shipping lists.
- J. Adhere to special requirements as specified in individual sections.

R23.00331.00

General Provisions for Mechanical Work

1.14 PROTECTION OF MATERIALS

- A. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed.
- B. Provide temporary storage facilities for materials and equipment.
- C. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
 - 1. Remove from site and provide new, duplicate, material, equipment, or apparatus in replacement of that rejected.
- D. Cover motors and other moving machinery to protect from dirt and water during construction. Rotate moving equipment, shafts, bearings, motors etc. to prevent corrosion and to circulate lubricants.
- E. Protect premises and work of other Divisions from damage arising out of installation of work of this Division.
 - 1. Contractor shall be responsible for the replacement of all damaged or defective work, materials or equipment. Do not install sensitive or delicate equipment until major construction work is completed.
 - 2. Remove replaced parts from premises.
- F. Make good any damage to the work caused by floods, storms, accidents, acts of God, acts of negligence, strikes, violence or theft up to time of final acceptance by the Owner.
- G. Do not leave any mechanical work in a hazardous condition, even temporarily.

1.15 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by representative of the Engineer.
- B. Advise Architect and Engineer that work is ready for review at following times:
 - 1. Prior to backfilling buried work.
 - 2. Prior to concealment of work in walls and above ceilings.
 - 3. When all requirements of Contract have been completed.
- C. Neither backfill nor conceal work without Engineer's consent.
- D. Maintain on job a set of Specifications and Drawings for use by Engineer's representatives.

1.16 SCHEDULE OF WORK

- A. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
- B. In scheduling, anticipate means of installing equipment through available openings in structure.
- C. Confirm in writing to Architect and Engineer, within 30 days of signing of contract, anticipated number of days required to perform test, balance, and acceptance testing of mechanical systems.
 - 1. This phase must occur after completion of mechanical systems, including all control calibration and adjustment, and requires substantial completion of the building, including closure, ceilings, lighting, partitioning, etc.
 - 2. Submit for approval at this time, names and qualifications of test and balancing agencies to be used.
- D. Arrange with Owner schedule for work in each area.
- E. Unless otherwise directed by Owner, perform work during normal working hours.

School DistrictGreenwood Lake UFSD - 2023 CIPGeneral Provisions for Mechanical Work230000 - 9

R23.00331.00

- F. Work delays:
 - 1. In case noisy work interferes with Owner's operations, Owner may require work to be stopped and performed at some other time, or after normal working hours.

1.17 ACCESS TO MECHANICAL WORK

- A. Access doors in walls and ceilings.
- B. Access Units Fire-Resistance Ratings: Where fire-resistance rating is indicated for construction penetrated by access units, provide UL listed-and-labeled units, except for units which are smaller than minimum size requiring ratings as recognized by governing authority.
- C. Product Data, Access Units: Submit manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.
- D. Furnish to the general contractor all access doors necessary for access through inaccessible wall or ceiling construction, for installation by the general contractor. Information on the size and location of the subject access doors is to be communicated in writing to the general contractors during the bidding period.

1.18 CONCRETE FOR MECHANICAL WORK

- A. Concrete for Mechanical Work
 - 1. Basins and curbs for mechanical equipment.
 - 2. Mechanical equipment foundations and housekeeping pads.
 - 3. Inertia bases for isolation of mechanical work.
 - 4. Rough grouting in and around mechanical work.
 - 5. Patching concrete cut to accommodate mechanical work.
- B. Quality control testing for concrete is required as work of this section.
- C. Concrete Work Codes and Standards:
 - 1. Comply with governing regulations and, where not otherwise indicated, comply with the following industry standards; whichever is the most stringent in its application to work in each instance.
 - a. ACI 301: "Specifications for Structural Concrete for Buildings"
 - b. ACI 311: "Recommended Practice for Concrete Inspection"
 - c. ACI 318: "Building Code Requirements for Reinforced Concrete"
 - d. ACI 347R: "Recommended Practice for Concrete Form work"
 - e. ACI 304R: "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
 - f. Concrete Reinforcing Steel Institute's, "Manual of Standard Practice"
- D. Submittals: Shop Drawings, Mechanical Concrete Work: Submit shop drawings for structural type concrete work, showing dimensions of formed shapes of concrete; bending, placement, sizes and spacing of reinforcing steel; location of anchors, isolation units, hangers and similar devices to be integrated with concrete work; and piping penetrations, access openings, inlets and other accessories and work to be accommodated by concrete work.
- E. Laboratory Test Reports, Mechanical Concrete Work: Submit laboratory test reports for concrete work materials, and for tested samples of placed concrete (where required as work of this section).

Greenwood Lake UFSD - 2023 CIP ork 230000 - 10

R23.00331.00

General Provisions for Mechanical Work

1.19 NOISE REDUCTION

- A. Cooperate in reducing objectionable noise or vibration caused by mechanical systems.
 1. To extent of adjustments to specified and installed equipment and appurtenances.
- B. Correct noise problems caused by failure to install work in accordance with Contract Documents.
 - 1. Include labor and materials required as result of such failure.

1.20 CUTTING AND PATCHING

- A. Provide all carpentry, cutting and patching required for proper installation of material and equipment specified.
- B. Do not cut or drill structural members without consent of Architect.

1.21 COORDINATION DRAWINGS

- A. Layout Shop Drawings Required:
 - 1. Prepare layout shop drawings for all areas; minimum 3/8 inch scale.
 - 2. Individual coordinated trade layout drawings are to be prepared for all areas.
 - 3. General Contractor is to assure that each trade has coordinated work with other trades, prior to submittal where submittal is required.
 - a. Include stamp on each submittal indicating that layout shop drawing has been coordinated.
 - 4. No layout shop drawing will be reviewed without stamped and signed coordinated assurance by General Contractor.
 - 5. All changes shall be clearly marked on each submitted layout drawing.
 - 6. Drawings shall show work of all trades including but not limited to'
 - a. Ductwork.
 - b. Piping: All Trades.
 - c. Mechanical Equipment.
 - d. Electrical Equipment.
 - e. Main Electrical conduits and bus ducts.
 - f. Equipment supports and suspension devices.
 - g. Structural and architectural constraints.
 - h. Show location of:
 - 1) Valves
 - 2) Piping specialties
 - 3) Dampers
 - 4) Access Doors
 - 5) Control and electrical panels
 - 6) Disconnect switches
 - 7. Drawings shall indicate coordination with work in other Divisions that must be incorporated in mechanical spaces, including, but not limited to:
 - a. Elevator equipment.
 - b. Cable trays not furnished under Division 16.
 - c. Computer equipment.
 - 8. Submission of drawings:
 - a. Prepare reproducible drawings.
 - b. Submit to other trades for review of space allocated to all trades.

R23.00331.00

General Provisions for Mechanical Work

- Greenwood Lake UFSD 2023 CIP k 230000 - 11
- c. Revise drawings to compensate for requirements of existing conditions and conditions created by other trades.
- d. Review revisions and other trades.
- e. Submit one reproducible and one blueline print to Engineer for review.
- 9. Final prepared drawings shall show that other trades affected have made reviews and signed, by each trade, at completions of coordination.
 - a. General Contractor
 - b. Include stamp on each submittal indicating that layout shop drawing has been coordinated.
- 10. No layout shop drawing will be reviewed without stamped and signed coordination assurance by General Contractor.

B. Shop Drawings:

- 1. Layout drawings of mechanical equipment rooms and penthouses showing all related equipment and equipment clearances required by other trades.
- 2. Layout drawings of areas in which it may be necessary to deviate substantially from layout shown on the drawings. Minor transitions in ductwork, if required due to job conditions, need not be submitted as long as the duct area is maintained. Show major relocation of ductwork and major changes in size of ducts. Coordinate shop drawings with all trades prior to ductwork fabrication.
- 3. Details of intermediate structural steel members required to span main structural steel for the support of ductwork.
- 4. Method of attachment of duct hangers to building construction.
- 5. Duct material, gage, type of joints and duct reinforcing for each size range, including sketches or SMACNA plate numbers for joints, method of fabrication and reinforcing.

1.22 GUARANTEE

- A. Furnish guarantee covering all work in accordance with general requirements of the contract for minimum period of one year. This guarantee shall exist for a period of one (1) year from the date of final acceptance of the work and shall apply to defects in materials and to defective workmanship of any kind.
- B. For factory-assembled equipment and devices on which the manufacturers furnish standard published guarantees as regular trade practice, obtain such guarantees and replace any such equipment that proves defective during the life of these guarantees.
- C. Guarantee all work for which materials are furnished, fabricated or field erected by the contractor, all factory-assembled equipment for which no specific manufacturer's guarantee is furnished, and all work in connection with installing manufacturer's guarantee is furnished, and all work in connection with installing manufacturer's guaranteed equipment.
- D. In the event of failure of any work, equipment or device during the life of the guarantee, repair or replace the equipment or defective work. Remove, replace or restore, at no cost to the Owner, any part of the structure or building which may be damaged either as the direct result of the defective work or in the course of the contractor's making replacement of the defective work or materials. Work shall be done at a time and in a manner as to cause no undue inconvenience to the Owner. Provide new materials, equipment, apparatus and labor to replace that determined by Engineer to be defective or faulty.
- E. This guarantee also applies to services including Instructions, Adjusting, Testing, Noise, Balancing, etc.

R23.00331.00

F. Additional equipment and material guarantees and warrantees may be indicated in other sections. In all cases, the more stringent guarantee or warrantee shall be provided.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT QUALITY

- A. Material and equipment furnished under this Division of specification shall be new. Defective or inferior materials must be replaced by contractor at no cost to Owner regardless of the stage of construction. Inferior material shall be defined as material or equipment of a quality or performance less than that specified as determined by the Owner's Representative.
- B. Provide each item of equipment with manufacturer's identification tag which is readily accessible and clearly shows model and size.

2.02 ACCESS TO MECHANICAL WORK

- A. Access Doors:
 - 1. General: Where walls and ceilings must be penetrated for access to mechanical work, access doors shall be provided. Furnish adequate size for intended and necessary access. Furnish doors with UL Fire Rating to match wall or ceiling construction. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.
- B. Access Door Construction: Refer to Section 083113 ACCESS DOORS AND FRAMES

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Tests:
 - 1. Perform as specified in individual sections, and as required by authorities having jurisdiction.
 - 2. Duration as noted.
- B. Provide required labor, material, equipment, and connections.
- C. Furnish written report and certification those tests have been satisfactorily completed.
- D. Repair or replace defective work, as directed.
- E. Pay for restoring or replacing damaged work due to tests as directed.
- F. Pay for restoring or replacing damaged work of others, due to tests, as directed.

3.02 ACCESS TO MECHANICAL WORK

- A. Coordinate installation and placement of access doors and panels with contractor for general construction.
- B. Remove or replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 230000

R23.00331.00

Mechanical and Electrical Coordination

Greenwood Lake UFSD - 2023 CIP n 230002 - 1

SECTION 230002 MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Work Included in This Section: Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Motors.
 - 2. Factory-wired equipment (FWE).
 - 3. Factory-wired control panels (FWCP).
 - 4. Motor controllers where provided as part of mechanical equipment.
 - 5. Motor controllers where supplied under Division 23 Mechanical Work.
 - 6. Disconnects and safety switches for mechanical equipment.
 - 7. Fuses for equipment provided, and starters and disconnect switches.
 - 8. Emergency Pushbutton Operator Station.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 23 HVAC Instrumentation and Controls, Motors.
- B. Installation and Power Wiring of Motor Controllers.

1.03 REFERENCE STANDARDS

- A. Published specifications standards, tests, or recommended methods of trade, industry or governmental organization as apply to work in this section where cited below:
 - 1. ANSI American National Standards Institute.
 - 2. NEMA National Electrical Manufacturer's Association.
 - 3. IEEE Institute of Electrical and Electronic Engineers.

1.04 QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards listed in Article 1.03 of this Section and with all applicable National, State and local codes.
- D. All items of a given-type shall be the products of the same manufacturer.

1.05 DIVISION OF WORK

A. This section delineates the work required to be performed by Contractors under Division 23 and Division 26.

1.06 WORK REQUIRED UNDER DIVISION 23

- A. Furnish motors, manual and combination starters, pushbutton devices, contactors, disconnect switches, electric thermostats, low voltage transformers, Emergency Break Glass Stations and other electrical devices required for equipment furnished.
- B. Install all items in piping and ductwork such as control valves, aquastats, ductstats, etc.

- C. All external wiring of equipment, all temperature control wiring, external wiring of control circuits of magnetic starters, interlocking wiring, boiler wiring, Emergency Break Glass Stations, and mounting of control devices, etc., shall be included under Division 23. All external wiring shall be in conduit. (Unless specifically shown to be provided by the Electrical Contractor)
- D. The Electrical Contractor, under Division 26, shall furnish and install all power wiring and conduit to junction box, to disconnect switch on unit, to motor starters and contactors, and between motor starters and contactors to motor or other load. Electrical Contractor shall be responsible for proper direction of rotation for all three phase equipment. The Electrical Contractor shall mount all starters, disconnects.
- E. Wiring required under Division 23 shall comply with the specifications as described in Division 26.
- F. The Plumbing Contractor, under Division 22, shall provide water and natural gas services to within two (2) feet of HVAC equipment requiring same and terminating with shut-off valves. The HVAC Contractor, under Division 23, shall make final connections to equipment.
- G. Provide disconnect switches or safety switches for equipment. (Unless specifically shown to be provided by the Electrical Contractor, starters and disconnects shown on the electrical drawings are for installation and do not require the Electrical Contractor to furnish units)
- H. Emergency Generator Exhaust muffler and flexible exhaust connection shall be furnished by the generator manufacturer under Division 26. Installation of the exhaust system including providing piping, insulation and accessories shall be included under Division 23.

1.07 SUBMITTALS

- A. Shop Drawings: Complete wiring diagrams of all power and control connections (standard diagrams will not be accepted). Deliver 2 copies of approved wiring diagrams to the Electric Contractor for installation of wiring and connections required under the Electric Contract.
- B. Product Data for Motor Controllers and Disconnect Switches: Manufacturer's catalog sheets, specifications and installation instructions. Submit enclosure type coordinated for service and location. Submit simultaneously with product data required for motors. Identify each controller for use with corresponding motor. Submit shop drawings and product data in accordance with project requirements.
- C. All warranties shall be delivered as part of the close-out submission.
- D. A receipt shall be delivered as part of the close-out submission that states all required spare parts have been delivered to the owner. This receipt must be signed and dated by the owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Motor Controllers and Disconnects
 - 1. Square D
 - 2. Allen-Bradley
 - 3. General Electric
 - 4. Cutler-Hammer
R23.00331.00

Mechanical and Electrical Coordination

2.02 MOTOR CONTROLLERS

- A. General: All starters shall be correctly sized to motor connected thereto. Provide one (1) additional auxiliary contact over and above that normally furnished, at least two (2) required. Provide overload heaters for each phase. Coordinate starters and controllers with the temperature control Contractor and sequence of operations.
- B. Minimum Size: The minimum allowable size of single or three phase magnetic motor controller is NEMA size 0.
- C. Enclosures: Unless otherwise indicated furnish NEMA 1 enclosures, except where installed outdoors furnish NEMA 3R enclosures.
- D. Control Power: Furnish control power transformer (maximum control voltage 120 volts) mounted within each magnetic motor controller enclosure.
- E. Pilot Lights: Furnish pilot lights of the neon lamp type mounted in the controller enclosure, green for running, red for not running.

2.03 MOTOR CONTROLLER TYPES:

- A. Type A (Full Voltage, Manual, Non-Magnetic):
 - 1. Allen-Bradley Co. Bulletin 609 (or Bulletin 600 single phase, 1 HP or less only).
 - 2. General Electric Co. CR-1062 (or CR-101 single phase, 1 HP or less only).
 - 3. Cutler-Hammer. B100 (or MS single phase, 1 HP or less only).
- B. Type A2 (2 Speed, 2 Winding, Full Voltage, Manual, Non-Magnetic):
 - 1. Allen-Bradley Co. Bulletin 609TS (or Bulletin 600 single phase, 1 HP or less only).
 - 2. General Electric Co. CR-1062 (or CR-101 single phase, 1 HP or less only).
 - 3. Square D Co. Class 2512, Type M (or Class 2512, Type F single phase, 1 HP or less only).
- C. Type B (Full Voltage Magnetic):
 - 1. Allen-Bradley Co. Bulletin 709.
 - 2. General Electric Co. CR-206.
 - 3. Square D Co. Class 8536.
 - 4. Cutler-Hammer. ECN05.
- D. Type B-COM (Combination Full Voltage Magnetic/Safety Switch):
 - 1. Allen-Bradley Co. Bulletin 712.
 - 2. General Electric Co. CR-208.
 - 3. Square D Co. Class 8538.
 - 4. Cutler-Hammer. ECN16.
- E. Type B2 (2 Speed, 2 Winding, Full Voltage, Magnetic):
 - 1. Allen-Bradley Co. Bulletin 715.
 - 2. General Electric Co. CR209.
 - 3. Square D Co. Class 8810.
 - 4. Cutler-Hammer. ECN33.
- F. Type C (Automatic, Reduced Voltage, Magnetic):
 - 1. Allen-Bradley Co. Bulletin 746.
 - 2. General Electric Co. CR-231.

R23.00331.00

Mechanical and Electrical Coordination

Greenwood Lake UFSD - 2023 CIP 230002 - 4

- 3. Square D Co. Class 8606.
- 4. Cutler-Hammer. ECA42.
- G. Type C-COM (Combination Automatic, Reduced Voltage, Magnetic/ Safety Switch):
 - 1. Allen-Bradley Co. Bulletin 746C.
 - 2. Square D Co. Class 8606.
 - 3. Cutler-Hammer. ECA43.
- H. Type D (Part Winding, Magnetic):
 - 1. Allen-Bradley Co. Bulletin 736.
 - 2. General Electric Co. CR-230.
 - 3. Square D Co. Class 8640.
 - 4. Cutler-Hammer. ECA45.

2.04 REMOTE PUSH BUTTON STATIONS

- A. Start-Stop with pilot light in NEMA 1 enclosure unless otherwise indicated.
 - 1. Allen-Bradley Co. Bulletin 800S.
 - 2. General Electric Co. CR-2943.
 - 3. Square D Co. Class 9001.
 - 4. Cutler-Hammer. Class 10250.

2.05 SAFETY SWITCHES

- A. General Electric Co. Type TH; Square D Co. Heavy Duty Series; Cutler-Hammer HD Series; with the following:
 - 1. Fused switches equipped with fuseholders to accept only the fuses specified in Section 16181 (U.L. Class RK-1, RK-5, L).
 - 2. NEMA 1 enclosure unless otherwise indicated on drawing or required. 3R for devices installed outdoors.
 - 3. Switch rated 240V for 120V, 208V, 240V, circuits; 600 V for 277V, 480V circuits.
 - 4. Switch rated 600V for 277V, 480V circuits.
 - 5. Solid neutral bus when neutral or grounding conductor is included with circuit.
 - 6. Current rating and number of poles as indicated on drawings.

2.06 NAMEPLATES

- A. Phenolic Type: Standard phenolic nameplates with 3/8" minimum size lettering engraved thereon.
- B. Embossed Aluminum: Standard stamped or embossed aluminum tags: Tech Products, Inc., Seton Name Plate Corp.

2.07 EMERGENCY PUSHBUTTON OPERATOR STATION

- A. Acceptable Manufacturer: Square D or equal.
- B. Switch Style: Class 9001, NEMA 4 rated emergency mushroom head pushbutton.
- C. Voltage: 120VAC, 60Hz as required.
- D. Contacts: 20A, 2-NO/2-NC contact.
- E. Operation: Manual.
- F. Normal position: Operator out.
- G. Activated position: Operator in.

R23.00331.00

Mechanical and Electrical Coordination

Greenwood Lake UFSD - 2023 CIP 1 230002 - 5

- H. Reset: Manual, turn to release.
- I. Enclosure: NEMA 4.

2.08 CUSTOM LEGEND PLATE

A. "EMERGENCY BOILER SHUTOFF"

PART 3 - EXECUTION

3.01 GENERAL

- A. Equipment shall be connected in a neat and skillful manner. Equipment deliver with terminal boxes that are inadequate shall be equipped with special boxes that suit the conditions by the Mechanical Contractor furnishing the equipment.
- B. In general, rigid conduit or tubing shall be used, but equipment that requires movement or that would transmit vibration to conduit shall be wired with flexible (liquid tight) steel conduit not over 18" long.
- C. All equipment shall be grounded with a green-covered ground wire run inside the conduit and connected to equipment frame on one end and to grounding system on the other end.
- D. All electrical work required in the Mechanical Contract shall conform to the applicable requirements of Division 26 of these Specifications.
- E. The Heating, Ventilating, and Air Conditioning Contractor shall assign all Electrical Work required under his contract to the approved Automatic Temperature Control Contractor, who shall perform this work with qualified electricians employed by that Contractor.
- F. The Mechanical Contractors shall cooperate with the Contractor for Electrical Work in making all necessary tests and in receiving, storing, and setting all motor-driven equipment, electrical devices, and controls furnished and/or installed under these contracts.
- G. Install heaters correlated with full load current of motors provided.
- H. Set overload devices to suit motors provided.

3.02 INSTALLATION

- A. Control Wiring:
 - 1. Provide control wiring and connections.
 - 2. Where control circuit interlocking is required between individually mounted motor controllers, provide a single pole on-off switch in a threaded type box mounted adjacent to motor safety switches which are remote from the control transformer (to enable interlock circuit to be opened when the motor safety switch is opened).
- B. Nameplates: Rivet or bolt the nameplate on the cover of NEMA 1 enclosures. Rivet or bolt and gasket the nameplate on cover of NEMA 3R or NEMA 12 enclosures. Provide phenolic or embossed aluminum nameplates as follows:
 - 1. On each remote control station, indicating motor controlled.
 - 2. On each interlock circuit switch, indicating purpose of switch.
- C. Emergency Pushbutton Operator Station: Wire all switches in series with boiler control branch circuits.

3.03 TYPES OF MOTOR CONTROLLERS REQUIRED FOR SINGLE SPEED MOTORS (SYSTEMS UNDER 250 VOLTS)

A. Single Phase Motors Less than 5 HP - Manually Operated: Type A.

- B. Single Phase Motors Less than 1/2 HP Automatically Operated: Type A.
- C. Single Phase Motors 1/2 to 5 HP Automatically Operated: Type B.
- D. Three Phase Squirrel Cage Motors Less than 7-1/2 HP: Type B (B-COM when indicated on drawings).
- E. Three Phase Squirrel Cage Motors 7-1/2 HP and Larger: Type C (C-COM when indicated on drawings).
- F. Three Phase Hermetically Sealed Compressor Motors Less than 7-1/2 HP: Type B.
- G. Three Phase Hermetically Sealed Compressor Motors 7-1/2 HP and Larger: Type D.

3.04 TYPES OF MOTOR CONTROLLERS REQUIRED FOR SINGLE SPEED MOTORS (277/480 VOLT SYSTEM)

- A. Single Phase Motors Less than 5 HP Manually Operated: Type A.
- B. Single Phase Motors Less than 1 HP Automatically Operated: Type A.
- C. Single Phase Motors 1 to 5 HP Automatically Operated: Type B.
- D. Three Phase Squirrel Cage Motors Less than 15 HP: Type B (B-COM when indicated on drawings).
- E. Three Phase Squirrel Cage Motors 15 HP and Larger: Type C (C-COM when indicated on drawings).
- F. Three Phase Hermetically Sealed Compressor Motors Less than 15 HP: Type B.
- G. Three Phase Hermetically Sealed Compressor Motors 15 HP and Larger: Type D.

3.05 TYPES OF MOTOR CONTROLLERS REQUIRED FOR 2 SPEED MOTORS (SYSTEMS UNDER 250 VOLTS)

- A. Single Phase Motors Less than 5 HP Manually Operated: Type A2.
- B. Single Phase Motors Less than 1/2 HP Automatically Operated: Type A2.
- C. Single Phase Motors 1/2 to 5 HP Automatically Operated: Type B2.
- D. Three Phase Squirrel Cage Motors Less than 7-1/2 HP: Type B2.

3.06 TYPES OF MOTOR CONTROLLERS REQUIRED FOR 2 SPEED MOTORS (277/480 VOLT SYSTEM)

- A. Single Phase Motors Less than 5 HP Manually Operated: Type A2.
- B. Single Phase Motors Less than 1 HP Automatically Operated: Type A2.
- C. Single Phase Motors 1 to 5 HP Automatically Operated: Type B2.
- D. Three Phase Squirrel Cage Motors Less than 15 HP: Type B2.

3.07 DISCONNECTS

- A. Motor Controllers: Provide safety switch for all motor controllers. Provide combination type starter-disconnect unless otherwise noted on drawings.
- B. Motors: Provide a disconnect switch for all motors. Provide a separate safety switch for motors which are not within sight of the starter.
- C. Provide safety switches for all factory packaged equipment.

R23.00331.00

Mechanical and Electrical Coordination

- D. Provide NEMA 3R safety switch for all rooftop and outdoor equipment.
- E. Provide unit mounted disconnect switches for all equipment such as unit heaters, fans, unit ventilators, incremental units, etc

3.08 EMERGENCY PUSHBUTTON OPERATOR STATION

- A. Provide Emergency Pushbutton Operator Station at each boiler room exit to de-energize the primary control circuit and to close the main fuel valves to stop the flow of fuel to the burner during an emergency.
- B. Review plans for locations.
- C. Provide all conduit and wiring for interlock of each boiler.

END OF SECTION 230002

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Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Common Motor Requirements for HVAC Equipment-CPL

230513 - 1

SECTION 230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS

A. Section 262913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. IEEE 112 IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C. NEMA MG 1 Motors and Generators; 2018.
- D. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. See Section 017800 Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Common Motor Requirements for HVAC Equipment-CPL

230513 - 2

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.
- B. Leeson Electric Corporation: www.leeson.com/#sle.
- C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.
- D. Substitutions: See Section 016000 Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Construction:
 - Open drip-proof type except where specifically noted otherwise. 1.
 - Design for continuous operation in 104 degrees F (40 degrees C) environment. 2.
 - Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, 3. service factor, and motor enclosure type.
- Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, Β. locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- C. Wiring Terminations:
 - Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials 1. indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type. Β.
- C. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

2.04 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors E. with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service F. Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

R23.00331.00

Common Motor Requirements for HVAC Equipment-CPL

Greenwood Lake UFSD - 2023 CIP

230513 - 3

2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 262913.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- M. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.06 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Applications:
 - 1. Commercial:
 - a. Roof Top Unit:
 - 1) Operating Mode: Constant speed.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the roof top unit and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - b. Power Roof Ventilator (PRV):
 - 1) Operating Mode: Constant cfm.
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the PRV and/or specified sequence of operation.
 - 3) Shaft Extension: Single.
 - c. Energy Recovery Ventilator:
 - 1) Operating Mode: Constant cfm.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Common Motor Requirements for HVAC Equipment-CPL

230513 - 4

- Input: Motor manufacturer to coordinate control requirements with the control 2) board of the energy recovery ventilator and/or specified sequence of operation.
- Shaft Extension: Single. 3)
- Hydronic Pump: d.
 - Operating Mode: Constant speed. 1)
 - 2) Input: Motor manufacturer to coordinate control requirements with the control board of the hydronic pump and/or specified sequence of operation.
 - 3) Flange Configuration: "C".

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- Install securely on firm foundation. Mount ball bearing motors with shaft in any position. Β.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 230513

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Sleeves and Sleeve Seals for HVAC Piping-

230517 - 1

CPL

SECTION 230517 SLEEVES AND SLEEVE SEALS FOR HVAC PIPING-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 230719 HVAC Piping Insulation-CPL.

1.03 REFERENCE STANDARDS

- A. ASTM C592 Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.
- B. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. 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.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- B. Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Sleeves and Sleeve Seals for HVAC Piping-

230517 - 2

CPL

- C. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- D. Pipe Passing Through Mechanical Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- E. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Modular/Mechanical Seal:
 - 1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
 - 2. Provide watertight seal between pipe and wall/casing opening.
 - 3. Elastomer element size and material in accordance with manufacturer's recommendations.
 - 4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.01 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.

3.02 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. 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. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 m).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
 - 1. Do not penetrate building structural members unless indicated.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Sleeves and Sleeve Seals for HVAC Piping-

230517 - 3

CPL

- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
 - 2. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
 - 3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. 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.
- H. 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.

3.03 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 230517

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Greenwood Lake UFSD - 2023 CIP Meters and Gauges for HVAC Piping-CPL

230519 - 1

R23.00331.00

SECTION 230519 METERS AND GAUGES FOR HVAC PIPING-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.
- C. Filter gauges.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 Pressure Gauges and Gauge Attachments; 2013.
- B. ASTM E1 Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved) 2020).
- C. ASTM E77 Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. UL 393 Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.04 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- Α Manufacturers:
 - Dwyer Instruments, Inc; : www.dwyer-inst.com/#sle. 1.
 - Moeller Instrument Company, Inc; ____: www.moellerinstrument.com/#sle. 2.
 - Omega Engineering, Inc; : www.omega.com/#sle. 3.
 - Substitutions: See Section 016000 Product Requirements. 4.
- Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, B. rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - Size: 4-1/2 inch (115 mm) diameter. 2.
 - Mid-Scale Accuracy: One percent. 3.
 - 4. Scale: Psi.

2.02 PRESSURE GAUGE TAPPINGS

- A. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).
- B. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) connections.
- C. Syphon: Steel, Schedule 40, 1/4 inch (6 mm) angle or straight pattern.

Greenwood Lake UFSD - 2023 CIP 230519 - 2

R23.00331.00

Meters and Gauges for HVAC Piping-CPL

2.03 STEM TYPE THERMOMETERS

- Α. Manufacturers:
 - Dwyer Instruments, Inc; _____: www.dwyer-inst.com/#sle. Omega Engineering, Inc; _____: www.omega.com/#sle. 1.
 - 2.
 - 3. Weksler Glass Thermometer Corp; : www.wekslerglass.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. 4.
- Thermometers Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; Β. lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch (225 mm) scale.
 - Window: Clear Lexan. 2.
 - Stem: 3/4 inch (20 mm) NPT brass. 3.
 - Accuracy: 2 percent, per ASTM E77. 4.
 - 5. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal B. air ducts, with brass perforated stem.

2.05 TEST PLUGS

Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 Α. mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F (93 degrees C).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
- C. Install pressure gauges on the inlet and outlet piping of all hydronic zones, hydronic coils, and heat transfer equipment.
- D. Install pressure gauges upsteam and downstream of all pressure reducing valves.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometers in the return duct, outside air duct, inlet duct, and supply duct of all air handling systems and terminal units.
- H. Install thermometers on the inlet and outlet piping of all hydronic zones, hydronic coils, and heat transfer equipment.

- I. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent to pressure gauges and pressure gauge taps.

END OF SECTION 230519

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Greenwood Lake UFSD - 2023 CIP General-Duty Valves for HVAC Piping-CPL

230523 - 1

R23.00331.00

SECTION 230523 GENERAL-DUTY VALVES FOR HVAC PIPING-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applications.
- B. Globe valves.
- C. Ball valves.
- D. Butterfly valves.
- E. Check valves.
- F. Gate valves.
- G. Chainwheels.

1.02 RELATED REQUIREMENTS

- A. Section 230553 Identification for HVAC Piping and Equipment-CPL.
- B. Section 230719 HVAC Piping Insulation-CPL.
- C. Section 232113 Hydronic Piping.
- D. Section 232213 Steam and Condensate Heating Piping.

1.03 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: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- TFE: Tetrafluoroethylene. I.
- WOG: Water, oil, and gas. J.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.10 Face-to-Face and End-to-End Dimensions of Valves; 2017.
- E. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- F. ASME B16.34 Valves Flanged, Threaded, and Welding End; 2020.
- G. ASME B31.9 Building Services Piping; 2020.

R23.00331.00

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- H. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
- I. ASTM A395/A395M Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).
- J. ASTM A536 Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- K. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- L. AWWA C606 Grooved and Shouldered Joints; 2015.
- M. MSS SP-45 Drain and Bypass Connections; 2020.
- N. MSS SP-67 Butterfly Valves; 2017, with Errata.
- O. MSS SP-68 High Pressure Butterfly Valves with Offset Design; 2021.
- P. MSS SP-70 Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- Q. MSS SP-71 Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- R. MSS SP-80 Bronze Gate, Globe, Angle, and Check Valves; 2019.
- S. MSS SP-110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.05 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 Owner'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.

1.06 QUALITY ASSURANCE

A. Manufacturer:

1.

- 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.

1.07 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.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 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.

R23.00331.00

General-Duty Valves for HVAC Piping-CPL

Greenwood Lake UFSD - 2023 CIP PL 230523 - 3

- 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
- C. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Provide the following valves for the applications if not indicated on drawings:
 - 1. Throttling (Hydronic): Ball and Globe.
 - 2. Throttling (Steam): Gate.
 - 3. Isolation (Shutoff): Gate and Ball.
- B. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 NPS (50 DN) and Smaller: Threaded ends.
 - b. 2-1/2 NPS (65 DN) and Larger: Grooved ends or flanged.
 - 2. Copper Tube:
 - a. 2 NPS (50 DN) and Smaller: Threaded ends (Exception: Solder-joint valve-ends).
 - 3. Steam and Steam Condensate Pipe: Grooved ends not acceptable.
- C. Heating Hot Water Valves:
 - 1. 2 NPS (50 DN) and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Ball: Full port, two piece, stainless steel trim.
 - c. Swing Check: Bronze disc, Class 125.
 - d. Globe: Bronze disc, Class 125.
 - 2. 2-1/2 NPS (65 DN) and Larger, Iron Valves:
 - a. Single-Flange Butterfly: 2-1/2 NPS (65 DN) to 12 NPS (300 DN), aluminum-bronze disc, EPDM seat, 200 CWP.
 - b. Grooved-End Butterfly: 2-1/2 NPS (65 DN) to 12 NPS (300 DN), 175 CWP.
 - c. Swing Check: Metal seats, Class 125.
 - d. Grooved-End Swing Check: 3 NPS (80 DN) to 12 NPS (300 DN), 300 CWP.
- D. Low Pressure Steam Valves (15 PSIG (104 kPa) or Less):
 - 2 NPS (50 DN) and Smaller, Brass and Bronze Valves:
 - a. Gate: NRS, Class 125.
 - b. Globe: Bronze disc, Class 125.
 - 2-1/2 NPS (65 DN) and Larger, Iron Valves:
 - a. Gate: NRS, Class 125.
- E. Steam-Condensate Valves:

1

2.

- 1. 2 NPS (50 DN) and Smaller, Brass and Bronze Valves:
 - a. Gate: NRS, Class 125.
 - b. Swing Check: Metal seats, Class 125.
- 2. 2-1/2 NPS (65 DN) and Larger, Iron Valves:
 - a. Swing Check: Metal seats, Class 125.
 - b. Gate: NRS, Class 125.

Greenwood Lake UFSD - 2023 CIP CPL 230523 - 4

R23.00331.00 General-Duty Valves for HVAC Piping-CPL

2.02 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 NPS (200 DN) and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 NPS (150 DN) and smaller.
 - 4. 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. Valves in Insulated Piping: Provide 2 NPS (50 DN) 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. Memory Stops: Fully adjustable after insulation is installed.
- F. 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 NPS (15 DN) through 24 NPS (600 DN): ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.
- G. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Building Services Piping Valves: ASME B31.9.
- H. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig: (1380 kPa).
 - 1. Comply with MSS SP-80, Type 1.
 - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 3. Ends: Threaded or solder joint.
 - 4. Stem and Disc: Bronze or PTFE.
 - 5. Packing: Asbestos free.
 - a. Handwheel: Malleable iron.

2.04 BRONZE, BALL VALVES

A. General:

R23.00331.00

General-Duty Valves for HVAC Piping-CPL

Greenwood Lake UFSD - 2023 CIP PL 230523 - 5

- 1. Fabricate from dezincification resistant material.
- 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psig (1035 kPa).
 - 3. CWP Rating: 600 psig (4140 kPa).
 - 4. Body: Forged bronze or dezincified-brass alloy.
 - 5. Ends: Threaded.
 - 6. Seats: PTFE.
 - 7. Stem: Stainless steel.
 - 8. Ball: Stainless steel, vented.

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style: Bi-directional dead-end service without use of downstream flange.
 - 1. Comply with MSS SP-67, Type I.
 - 2. CWP Rating: 150 psig (1035 kPa) and 200 psig (1680 kPa).
 - 3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
 - 4. Stem: One or two-piece stainless steel.
 - 5. Seat: NBR.
 - 6. Disc: Coated ductile iron.

2.06 IRON, GROOVED-END BUTTERFLY VALVES

- CWP Rating: 175 psig (1200 kPa), 300 psig (2070 kPa): 8 NPS (50 DN) or smaller, and 200 psig (1389 kPa): 10 NPS (250 DN) or larger.
 - 1. Comply with MSS SP-67, Type I.
 - 2. Body: Coated ductile iron.
 - 3. Stem: Stainless steel.
 - 4. Disc: Coated ductile iron.
 - 5. Disc Seal: EPDM.

2.07 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug type: Bi-directional dead end service without downstream flange.
 - 1. Comply with MSS SP-68.
 - 2. Class 150: CWP Rating: 285 psig (1965 kPa) and Class 300: CWP Rating: 720 psig (4965 kPa) at 100 degrees F (38 degrees C).
 - 3. Body: Provide carbon steel, cast iron, ductile Iron, or stainless steel.
 - 4. Seat: Metal or reinforced PTFE.
 - 5. Offset stem: Stainless steel.
 - 6. Disc: Carbon steel.

2.08 BRONZE, SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa) and Class 150: CWP Rating: 300 psig (2070 kPa).
 - 1. Comply with MSS SP-80, Type 3.
 - 2. Body Design: Horizontal flow.
 - 3. Body Material: Bronze, ASTM B62.
 - 4. Ends: Threaded.
 - 5. Disc: Bronze.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP

230523 - 6

General-Duty Valves for HVAC Piping-CPL

2.09 IRON, FLANGED END SWING CHECK VALVES

- Class 125: CWP Rating: 200 psig (1380 kPa) with Metal Seats. A.
 - Comply with MSS SP-71, Type I. 1.
 - 2. Design: Clear or full waterway with flanged ends.
 - Body: Gray iron with bolted bonnet in accordance with ASTM A126. 3.
 - 4. Trim: Bronze.
 - Disc Holder: Bronze. 5.
 - Gasket: Asbestos free. 6.

2.10 IRON, GROOVED-END SWING CHECK VALVES

- A. 300 CWP:
 - 2 NPS (50 DN) to 8 NPS (200 DN). 1.
 - 2. CWP Rating: 300 psig (2070 kPa).
 - 3. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
 - 4. Seal: EPDM or Nitrile.
 - Disc: Ductile iron. 5.
 - 6. Coating: Black, non-lead paint.

2.11 BRONZE, GATE VALVES

- A. Non-Rising Stem (NRS) or Rising Stem (RS):
 - 1. Comply with MSS SP-80, Type I.
 - 2. Class 150: CWP Rating: 300 psig (2070 kPa).
 - 3. Body Material: Bronze with integral seat and union-ring bonnet.
 - 4. Ends: Threaded.
 - 5. Stem: Bronze.
 - 6. Disc: Solid wedge; bronze.
 - 7. Packing: Asbestos free.
 - Handwheel: Malleable iron, bronze, or aluminum. 8.

2.12 IRON, GATE VALVES

- A. NRS or OS&Y:
 - 1. Comply with MSS SP-70, Type I.
 - Body Material: Gray iron with bolted bonnet. 2.
 - Ends: Flanged. 3.
 - Trim: Bronze. 4.
 - 5. Disc: Solid wedge.
 - 6. Packing and Gasket: Asbestos free.

PART 3 EXECUTION

3.01 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.

Greenwood Lake UFSD - 2023 CIP General-Duty Valves for HVAC Piping-CPL 230523 - 7

R23.00331.00

3.02 INSTALLATION

- Provide unions or flanges with valves to facilitate equipment removal and maintenance while Α. maintaining system operation and full accessibility for servicing.
- Provide separate valve support as required and locate valve with stem at or above center of Β. piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION 230523

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R23.00331.00

Greenwood Lake UFSD - 2023 CIP Hangers and Supports for HVAC Piping and Equipment-CPL

230529 - 1

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Concrete equipment pads.
- В. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- Β. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2014 (Reapproved 2020).
- D. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
- F. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- G. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- H. ASTM E96/E96M Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.
- MFMA-4 Metal Framing Standards Publication; 2004. Ι.
- MSS SP-58 Pipe Hangers and Supports Materials, Design, Manufacture, Selection, J. Application, and Installation; 2018.
- K. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- Coordination: A.
 - 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.
 - Coordinate compatibility of support and attachment components with mounting surfaces at 3. the installed locations.
 - Coordinate the arrangement of supports with ductwork, piping, equipment and other 4. potential conflicts installed under other sections or by others.

R23.00331.00

- 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - Do not install products on or provide attachment to concrete surfaces until concrete has 1 fully cured in accordance with Section 033000.

1.05 SUBMITTALS

- See Section 013000 Administrative Requirements, for submittal procedures. Α.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- Shop Drawings: Include details for fabricated hangers and supports where materials or C. methods other than those indicated are proposed for substitution.
 - Application of protective inserts, saddles, and shields at pipe hangers for each type of 1. insulation and hanger.
- D. 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.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Installer Qualifications for Field-Welding: As specified in Section 055000.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having iurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- General Requirements: Α
 - Comply with MSS SP-58. 1.
 - 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - Provide products listed, classified, and labeled as suitable for the purpose intended, where 3. applicable.
 - Where support and attachment component types and sizes are not indicated, select in 4. accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 4.0. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless 5. specifically indicated or permitted.
 - 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for HVAC Piping and Equipment-CPL 230529 - 3

- a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
- b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
- c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
- d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: Comply with Section 055000.
- C. 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. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Ferguson Enterprises Inc: www.fnw.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - 2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 3. Comply with MFMA-4.
 - 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, 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 (2.66 mm).
 - 6. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
- D. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm) diameter.
 - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch (6 mm) diameter.
 - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch (10 mm) diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) diameter.
- E. Thermal Insulated Pipe Supports:
 - 1. Manufacturers:
 - a. Buckaroos, Inc: www.buckaroos.com/#sle.
 - b. KB Enterprises: www.snappitz.com/#sle.
 - 2. General Construction and 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. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch (12.7 mm to 762 mm) iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
 - 3. PVC Jacket:

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for HVAC Piping and 230529 - 4 Equipment-CPL

- a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
- b. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
- c. Maximum Service Temperature: 180 degrees F (82 degrees C).
- d. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
- e. Thickness: 60 mil (1.524 mm).
- f. Connections: Brush on welding adhesive.
- 4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- 5. Products:
 - a. Buckaroos, Inc; CoolDry: www.buckaroos.com/#sle.
- F. Pipe Supports:
 - 1. Liquid Temperatures Up To 122 degrees F (50 degrees C):
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 - 2. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
 - b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
 - c. Sliding Support: MSS SP-58 Types 35 through 38.
- G. Pipe Stanchions: For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
 - 1. Manufacturers:
 - a. Anvil International; H-Block: www.anvilintl.com/#sle.
 - 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- H. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
 - 1. Manufacturers:
 - a. Ferguson Enterprises Inc: www.fnw.com/#sle.
 - 2. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 - 3. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- I. Riser Clamps:
 - 1. Manufacturers:
 - a. Ferguson Enterprises Inc; ____: www.fnw.com/#sle.
 - 2. Provide copper plated clamps for copper tubing support.
 - 3. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- J. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.
- K. Strut Clamps: Two-piece pipe clamp.
- L. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for HVAC Piping and Equipment-CPL

230529 - 5

- M. Pipe Hangers: For a given pipe run, use hangers of the same type and material.
 - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- N. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
 - 1. Pipe Diameter 6 inches (150 mm) and Smaller: Provide minimum clearance of 0.16 inch (4 mm).
 - 2. Pipe Diameter 8 inches (200 mm): Provide U-bolts with double nuts providing minimum clearance of 0.28 inch (7 mm).
 - 3. Pipe Diameter 8 inches (200 mm): 0.625 inch (16 mm) U-bolt.
 - 4. Pipe Diameter 10 inches (250 mm): 0.75 inch (19 mm) U-bolt.
 - 5. Pipe Diameter 12 to 16 inches (300 to 400 mm): 0.875 inch (24 mm) U-bolt.
 - 6. Pipe Diameter 18 to 30 inches (450 to 750 mm): 1 inch (25 mm) U-bolt.
- O. Pipe Alignment Guides: Galvanized steel.
 - 1. Pipe Diameter 8 inches (200 mm) and Smaller: Spider or sleeve type.
 - 2. Pipe Diameter 10 inches (250 mm) and Larger: Roller type.
- P. 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.
- Q. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Manufacturers:
 - a. Anvil International; H-Block: www.anvilintl.com/#sle.
 - b. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - c. Erico International Corporation, a brand of Pentair: www.erico.com/#sle.
 - d. Ferguson Enterprises Inc: www.fnw.com/#sle.
 - e. PHP Systems/Design: www.phpsd.com/#sle.
 - f. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - 2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 - 3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 5. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
- R. Pipe Shields for Insulated Piping:
 - 1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - 2. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
 - d. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for HVAC Piping and Equipment-CPL

230529 - 6

- e. Maximum Service Temperature: 178 degrees F (81 degrees C).
- f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- S. 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. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 2. Manufacturers Powder-Actuated Fastening Systems:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 6. Hollow Masonry: Use toggle bolts.
 - 7. Hollow Stud Walls: Use toggle bolts.
 - 8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 9. Sheet Metal: Use sheet metal screws.
 - 10. Wood: Use wood screws.
 - 11. Plastic and lead anchors are not permitted.
 - 12. Hammer-driven anchors and fasteners are not permitted.
 - 13. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 - 14. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- T. Pipe Installation Accessories:
 - 1. Copper Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 2. Thermal Insulated Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 3. Overhead Pipe Supports:
 - a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - 4. Plenum Pipe Supports:

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Hangers and Supports for HVAC Piping and Equipment-CPL

230529 - 7

- a. Manufacturers:
 - 1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- Telescoping Pipe Supports: 5.
 - a. Manufacturers:
 - HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - Inserts and Clamps:
 - a. Manufacturers:
 - HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle. 1)

2.02 RETROFIT PIPING COVER SYSTEM

A. Manufacturers:

6.

- 1. DecoShield Systems, Inc: www.decoshield.com/#sle.
- B. General Requirements:
 - Surface Burning Characteristics: Flame spread index/smoke developed index of 20/250, 1. maximum, when tested in accordance with ASTM E84 or UL 723.

C. Materials:

- Piping Cover System: Removal-resistant, modular, snap-fit cover units, clips, and anchors 1. for use with CPVC, steel, and copper piping systems.
- Cover Units: L-shaped and U-shaped cross-section units of flame retardant resin 2. material, paintable finish.
- Unit Length: 7.5 feet (2.29 m). 3.
- Provide coupling fittings for joining units end to end and prefabricated inside and outside 4. corner fittings and end caps as required.
- 5. Provide mounting clips to secure covers to wall-ceiling per manufacturer requirements.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) Β. evaluation report conditions of use where applicable.
- Provide independent support from building structure. Do not provide support from piping, C. ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Field-Welding (where approved by Architect): Comply with Section 055000.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Hangers and Supports for HVAC Piping and Equipment-CPL

230529 - 8

- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- I. 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. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 033000.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- K. Secure fasteners according to manufacturer's recommended torque settings.
- L. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 BSD 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 230529

R23.00331.00

Wind Restraint for HVAC Systems

Greenwood Lake UFSD - 2023 CIP 230550 - 1

SECTION 230550 WIND RESTRAINT FOR HVAC SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Support and brace mechanical and electrical systems, as called for, to resist directional wind forces (lateral, longitudinal and vertical).

1.03 APPLICABLE CODES AND STANDARDS

- A. Provide work in compliance with the following codes and standards:
- B. 2020 International Building Code (Section 1609).
- C. 2020 International Mechanical Code (Section 301, Item 301.15).
- D. American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures with Supplement No. 1 Standard ASCE/SEI 7-10.

1.04 QUALITY ASSURANCE

- A. General:
 - 1. The contractor shall provide professional engineer stamped and signed calculations, and details of wind restraint systems to meet total design lateral force requirements for support and restraint of mechanical and electrical systems.
 - 2. Systems requiring wind restraint including, but not limited to:
 - a. Exhaust fans.
 - b. Hooded intake or relief ventilators.
 - c. Ductwork.
 - d. Rooftop air handling equipment.
 - e. Condensing units.
 - f. Miscellaneous HVAC equipment.
 - g. Roof curbs and pipe/duct/equipment supports associated with any of the equipment listed above.

1.05 SUBMITTALS

- A. Submit wind force level (Fp) calculations from applicable building code. Submit pre- approved restraint selections, installation details, and plans indicating locations of restraints.
- B. Calculations, plans, restraint selection, and installation details shall be stamped and signed by a professionally licensed engineer experienced in wind restraint design.
- C. Submit manufacturer's product data.
- D. For each piece of equipment that requires wind restraint as outlined in this section, include the following:
 - 1. Dimensioned Outline Drawings of Equipment Unit: Identify the center of gravity and locate and describe mounting and anchoring provisions.

R23.00331.00

Wind Restraint for HVAC Systems

2. Anchorage: Provide detailed description of equipment anchorage devices on which the calculations are based and their installation requirements. Identify anchor bolts, studs and other mounting devices. Provide information on the size, type and spacing of mounting brackets, holes and other provisions.

PART 1 PRODUCTS

2.01 CODE INFORMATION

- A. This project is subject to the wind bracing requirements of the 2015 International Building Code (Section 1609) and American Society of Civil Engineers ASCE/SEI 7-10. The following criteria are applicable to this project:
 - 1. Nominal Design Wind Speed (V) (Per ASCE 7-10): 120 mph.
 - 2. Risk Category (Per ASCE 7-10): III
 - 3. Exposure Category (Per ASCE 7-10): C
 - 4. Height and Exposure Adjustment Coefficient (Per ASCE 7-10): 1.21

2.02 WIND BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 - 1. Design analysis shall include calculated dead loads, wind loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 - 2. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
 - 3. All wind restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in Section 2.1.
- B. Friction from gravity loads shall not be considered resistance to wind forces.

PART 1 EXECUTION

3.01 INSTALLATION

- A. Wind Restraint of Ductwork and Equipment:
 - 1. All restraint systems shall be installed in strict accordance with the manufacturer's restraint guidelines and all certified submittal data.
 - 2. The interaction between mechanical and electrical equipment and the supporting structures shall be designed into the restraint systems.
 - 3. Friction clips shall not be used for anchorage attachments.
 - 4. Expansion anchors shall not be used for non-vibration isolated equipment rated over 10 HP.
 - 5. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction and vertical restraints shall be provided to resist overturning.
 - 6. Installation of restraints shall not cause any change in position of equipment or ductwork, resulting in stresses or misalignment.
 - 7. Exhaust fans with hinge kits shall have wind restraint fasteners installed on the hinged side, same as the three (3) non-hinged sides.
 - 8. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
 - 9. Do not install any equipment or duct that makes rigid connections with the building unless isolation is not specified.
 - 10. Prior to installation, bring to the Architect's/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- 11. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult Structural Engineer of record.
- 12. Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The Contractor shall submit loads to the Structural Engineer of record for approval in this event.
- 13. Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
- 14. Provide reinforced clevis bolts where required.
- 15. Do not brace a system to two independent structures such as a roof and wall.

END OF SECTION 230550

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Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Identification for HVAC Piping and Equipment-CPL

230553 - 1

SECTION 230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. See Section 013000 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 valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks, where located above lay-in ceiling.
- F. Ductwork: Adhesive-backed duct markers or stencils.
- G. Heat Transfer Equipment: Nameplates.
- H. Instrumentation: Tags.
- I. Major Control Components: Nameplates.
- J. Piping: Pipe markers.
- K. Pumps: Nameplates.
- L. Relays: Tags.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Identification for HVAC Piping and Equipment-CPL

230553 - 2

- M. Small-sized Equipment: Tags.
- N. Tanks: Nameplates.
- O. Thermostats: Nameplates.
- P. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- Q. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
- B. Letter Color: White.
- C. Letter Height: 1/4 inch (6 mm).
- D. Background Color: Black.
- E. Plastic: Comply with ASTM D709.

2.03 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. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 6. Seton Identification Products, a Tricor Company: 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 (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 ADHESIVE-BACKED DUCT MARKERS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 3. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
- B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.
- C. Style: Individual Label.
- D. Color: Green/White Green/White.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Identification for HVAC Piping and Equipment-

230553 - 3

CPL

2.05 STENCILS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 - 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
 - 2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
 - 3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
 - 4. 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
 - 5. Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.
- C. Stencil Paint: As specified in Section 099123, semi-gloss enamel, colors complying with ASME A13.1.

2.06 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation; _____: www.bradycorp.com/#sle.
 - 2. Brimar Industries, Inc; _____: www.pipemarker.com/#sle.
 - 3. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
 - 4. Kolbi Pipe Marker Co; ______ www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products, a Tricor Company; ____: www.seton.com/#sle.
- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- E. Color code as follows:
 - 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.

2.07 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
 - 1. HVAC Equipment: Yellow.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Identification for HVAC Piping and Equipment-

230553 - 4

CPL

- 2. Fire Dampers and Smoke Dampers: Red.
- 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install 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. Apply stencil painting in accordance with Section 099123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Install ductwork with adhesive-backed duct markers. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Locate ceiling tacks to locate dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 230553

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Testing, Adjusting, and Balancing for HVAC-CPL

230593 - 1

SECTION 230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 019113 General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 230800 Commissioning of HVAC.

1.03 REFERENCE STANDARDS

- A. AABC (NSTSB) AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- C. NEBB (TAB) Procedural Standard for Testing Adjusting and Balancing of Environmental Systems; 2019.
- D. SMACNA (TAB) HVAC Systems Testing, Adjusting and Balancing; 2002.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Final test report forms to be used.
 - e. Expected problems and solutions, etc.
 - f. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Testing, Adjusting, and Balancing for HVAC-CPL

230593 - 2

- 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 Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. SMACNA (TAB).
- 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 three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; 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.

3.02 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.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Testing, Adjusting, and Balancing for HVAC-

230593 - 3

CPL

- 3. Final filters are clean and in place. If required, install temporary media in addition to final filters.
- 4. Duct systems are clean of debris.
- 5. Fans are rotating correctly.
- 6. Fire and volume dampers are in place and open.
- 7. Air coil fins are cleaned and combed.
- 8. Access doors are closed and duct end caps are in place.
- 9. Air outlets are installed and connected.
- 10. Duct system leakage is minimized.
- 11. Hydronic systems are flushed, filled, and vented.
- 12. Pumps are rotating correctly.
- 13. Service and balance valves are open.
- 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.

3.03 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations.
- B. Provide additional balancing devices as required.

3.04 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.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

R23.00331.00

Testing, Adjusting, and Balancing for HVAC-CPL

- 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. 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.
- E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- H. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- I. Where modulating dampers are provided, take measurements and balance at extreme conditions.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Air Cooled Refrigerant Condensers.
 - 2. Terminal Heat Transfer Units.
 - 3. Fans.
 - 4. Air Inlets and Outlets.

3.09 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.

R23.00331.00

Testing, Adjusting, and Balancing for HVAC-

230593 - 5

Greenwood Lake UFSD - 2023 CIP

CPL

- 5. RPM.
- 6. Service factor.
- 7. Starter size, rating, heater elements.
- 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
 - 1. Identification/location.
 - 2. Required driven RPM.
 - 3. Driven sheave, diameter and RPM.
 - 4. Belt, size and quantity.
 - 5. Motor sheave diameter and RPM.
 - 6. Center to center distance, maximum, minimum, and actual.
- C. Air Cooled Condensers:
 - 1. Identification/number.
 - 2. Location.
 - 3. Manufacturer.
 - 4. Model number.
 - 5. Serial number.
 - 6. Entering DB air temperature, design and actual.
 - 7. Leaving DB air temperature, design and actual.
 - 8. Number of compressors.

D. Heating Coils:

- 1. Identification/number.
- 2. Location.
- 3. Service.
- 4. Manufacturer.
- 5. Air flow, design and actual.
- 6. Water flow, design and actual.
- 7. Water pressure drop, design and actual.
- 8. Entering water temperature, design and actual.
- 9. Leaving water temperature, design and actual.
- 10. Entering air temperature, design and actual.
- 11. Leaving air temperature, design and actual.
- 12. Air pressure drop, design and actual.
- E. Exhaust Fans:
 - 1. Location.
 - 2. Manufacturer.
 - 3. Model number.
 - 4. Serial number.
 - 5. Air flow, specified and actual.
 - 6. Total static pressure (total external), specified and actual.
 - 7. Inlet pressure.
 - 8. Discharge pressure.
 - 9. Sheave Make/Size/Bore.
 - 10. Number of Belts/Make/Size.
 - 11. Fan RPM.

R23.00331.00

Testing, Adjusting, and Balancing for HVAC-

230593 - 6

Greenwood Lake UFSD - 2023 CIP

CPL

F. Duct Traverses:

- 1. System zone/branch.
- 2. Duct size.
- 3. Area.
- 4. Design velocity.
- 5. Design air flow.
- 6. Test velocity.
- 7. Test air flow.
- 8. Duct static pressure.
- G. Flow Measuring Stations:
 - 1. Identification/number.
 - 2. Location.
 - 3. Size.
 - 4. Manufacturer.
 - 5. Model number.
 - 6. Serial number.
 - 7. Design Flow rate.
 - 8. Design pressure drop.
 - 9. Actual/final pressure drop.
 - 10. Actual/final flow rate.
 - 11. Station calibrated setting.
- H. Terminal Unit Data:
 - 1. Manufacturer.
 - 2. Type, constant, variable, single, dual duct.
 - 3. Identification/number.
 - 4. Location.
 - 5. Model number.
 - 6. Size.
 - 7. Minimum static pressure.
 - 8. Minimum design air flow.
 - 9. Maximum design air flow.
 - 10. Maximum actual air flow.
 - 11. Inlet static pressure.
- I. 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.

Greenwood Lake Union F	ree School District	Greenwood Lake UFSI) - 2023 CIP
R23.00331.00	Testing, Adjusting, and Balancing fo CPL	or HVAC-	230593 - 7

10. Percent of design air flow.

END OF SECTION 230593

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R23.00331.00

HVAC Piping Insulation-CPL

Greenwood Lake UFSD - 2023 CIP 230719 - 1

SECTION 230719 HVAC PIPING INSULATION-CPL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 232113 Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 232213 Steam and Condensate Heating Piping: Placement of hangers and hanger inserts.
- D. Section 232300 Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- C. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- D. ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- E. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- F. ASTM C449 Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- G. ASTM C534/C534M Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020a.
- H. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation; 2019.
- I. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- J. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2021.
- K. ASTM D610 Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
- L. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- M. ASTM E96/E96M Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022.
- N. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

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

1.05 QUALITY ASSURANCE

- Manufacturer Qualifications: Company specializing in manufacturing the Products specified in Α. this section with not less than three years of documented experience.
- Applicator Qualifications: Company specializing in performing the type of work specified in this Β. section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 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

2.01 REGULATORY REQUIREMENTS

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

2.02 GLASS FIBER, RIGID

- A. Manufacturers:
 - CertainTeed Corporation; _____: www.certainteed.com/#sle. Johns Manville Corporation; _____: www.jm.com/#sle. 1.
 - 2.
 - Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: www.knaufinsulation.com/#sle. 3.
 - Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: 4. www.ocbuildingspec.com/#sle.
 - 5. Owens Corning Corporation; VaporWick Pipe Insulation: www.ocbuildingspec.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. 6.
- Insulation: ASTM C547 and ASTM C795: rigid molded, noncombustible. B.
 - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - Maximum Service Temperature: 850 degrees F (454 degrees C). 2.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 - K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C). 1.
 - Maximum Service Temperature: 220 degrees F (104 degrees C). 2.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. 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 perminches (0.029 ng/Pa s m).
- E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

R23.00331.00

HVAC Piping Insulation-CPL

Greenwood Lake UFSD - 2023 CIP 230719 - 3

- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - 2. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
 - 3. Weave: 5 by 5.
- I. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- J. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): www.aeroflexusa.com/#sle.
 - 2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
 - 3. K-Flex USA LLC; K-Flex Titan: www.kflexusa.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 180 degrees F (82 degrees C).
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation; _____: www.jm.com/#sle.
 - b. Substitutions: See Section 016000 Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.

R23.00331.00

HVAC Piping Insulation-CPL

Greenwood Lake UFSD - 2023 CIP 230719 - 4

- 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- C. Vapor Barrier Membranes: ASTM C1136, Type IX.
 - 1. Multilayer Laminate Vapor Barrier:
 - a. Thickness: 2.4 mil (0.06 mm).
 - b. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
 - c. Manufacturers:
 - 1) Polyguard Products; ZERO-PERM: www.polyguardproducts.com/#sle.
 - 2) Substitutions: See Section 016000 Product Requirements.

2.05 ACCESSORIES

- A. General Requirements:
 - 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 - 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
 - 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 - 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:

b.

- 1. Corrosion Control Gel:
 - a. Manufacturers:
 - 1) Polyguard Products; RG2400LT: www.polyguardproducts.com/#sle.
 - 2) Substitutions: See Section 016000 Product Requirements.
 - Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump 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 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- H. 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.
- I. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches (40 mm) 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 (150 mm) 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.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- L. Concealed Piping: Finish with fitting covers on flanges, fittings, valves, and specialties.
- M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

3.03 SCHEDULE

- A. Heating Systems:
 - 1. Heating Water Supply and Return:
 - a. NPS 1-1/4 and Smaller: 1-1/2 inch thick Rigid Glass Fiber.
 - b. NPS 1-1/2 and Larger: 2 inch thick Rigid Glass Fiber.
 - 2. Low Pressure Steam Piping (250 deg. F and Below):
 - a. NPS 3-1/2 and Smaller: 2-1/2 inch thick Rigid Glass Fiber.
 - b. NPS 4 and Larger: 3 inch thick Rigid Glass Fiber.
 - 3. Low Pressure, Gravity, and Pumped Steam Condensate:
 - a. NPS 3-1/2 and Smaller: 2-1/2 inch thick Rigid Glass Fiber.
 - b. NPS 4 and Larger: 3 inch thick Rigid Glass Fiber.
- B. Cooling Systems:
 - 1. Chilled Water:
 - a. NPS 3 and Smaller: 1-1/2 inch thick Rigid Glass Fiber with Vapor Barrier.
 - b. NPS 4 to NPS 12: 2 inch thick Rigid Glass Fiber with Vapor Barrier.
 - 2. Cold Condensate Drains:

R23.00331.00

HVAC Piping Insulation-CPL

Greenwood Lake UFSD - 2023 CIP 230719 - 6

- a. All Sizes: 1/2 inch thick Rigid Glass Fiber with Vapor Barrier.
- b. All Sizes: 3/4 inch thick Flexible Elastomeric Cellular with Vapor Barrier.
- 3. Condensate Drains from Cooling Coils:
 - a. All Sizes: 1/2 inch thick Rigid Glass Fiber with Vapor Barrier.
 - b. All Sizes: 3/4 inch thick Flexible Elastomeric Cellular with Vapor Barrier.
- 4. Refrigerant Suction:
 - a. All Sizes: 1-1/2 inch thick Flexible Elastomeric Cellular with Vapor Barrier.
- 5. Refrigerant Hot Gas:
 - a. All Sizes: 1-1/2 inch thick Flexible Elastomeric Cellular with Vapor Barrier.
- C. Outdoor Systems:
 - 1. Refrigerant Suction and Hot Gas:
 - a. All Sizes: 2 inch thick Flexible Elastomeric Cellular with Vapor Barrier and Aluminum Jacket.

END OF SECTION 230719

ree School DistrictGreenwood Lake UFSD - 2023 CIPInstrumentation and Control Devices for HVAC230913 - 1

R23.00331.00

SECTION 230913 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Control panels.
- B. Control Valves:
 - 1. Ball valves and actuators.
 - 2. Globe pattern.
 - 3. Electronic operators.
- C. Pressure independent valves and actuators.
- D. Dampers.
- E. Damper Operators:
- 1. Electric operators.
- F. Input/Output Sensors:
 - 1. Temperature sensors.
 - 2. Humidity sensors.
 - 3. Static pressure (air pressure) sensors.
 - 4. Equipment operation (current) sensors.
 - 5. Damper position indicators.

1.02 RELATED REQUIREMENTS

- A. Section 230519 Meters and Gauges for HVAC Piping-CPL: Thermometer sockets and gauge taps.
- B. Section 230923 Direct-Digital Control System for HVAC.
- C. Section 230993 Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ANSI/FCI 70-2 Control Valve Seat Leakage; 2021.
- C. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Manufacturer's Instructions: Provide for all manufactured components.
- E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

R23.00331.00

ree School DistrictGreenwood Lake UFSD - 2023 CIPInstrumentation and Control Devices for HVAC230913 - 2

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Substantial Completion.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

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

2.02 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

2.03 CONTROL VALVES

- A. Ball Valves and Actuators:
 - 1. Service: Use for chilled water, hot water, or steam at 15 to 25 psig (104.4 to 172.4).
 - 2. Flow Characteristic: Include 2-way, 3-way diverting, and 3-way mixing operation.
 - a. Heating Hot Water: Configure to fail normally open.
 - b. Chilled Water: Configure to fail normally closed.
 - 3. Provide pressure-independent type.
 - 4. Rangeability: 500 to 1.
 - 5. ANSI Rating: Class 150.
 - 6. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
 - 7. Body Size:
 - a. Under 2-1/2 inches (64 mm):
 - 1) Connection: NPT.
 - 2) Materials:
 - (a) Body: Brass.
 - (b) Flanges: Ductile iron.
 - (c) Ball: 300 series stainless steel.
 - (d) Stem: 300 series stainless steel.
 - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
 - (f) Stem Seal: EPDM O-Rings.

R23.00331.00

Instrumentation and Control Devices for HVAC

Greenwood Lake UFSD - 2023 CIP VAC 230913 - 3

(g) Flow Control Disk: Thermoplastic synthetic-resin.

- b. 2-1/2 inches (64 mm) and Above:
 - 1) Connection Type: Flanged.
 - 2) Materials:
 - (a) Body: Brass.
 - (b) Flanges: Ductile iron.
 - (c) Ball: 300 series stainless steel.
 - (d) Stem: 300 series stainless steel.
 - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
 - (f) Stem Seal: EPDM O-Rings.
 - (g) Flow Control Disk: Thermoplastic synthetic-resin.
- c. Service Temperature:
 - 1) Fluid Side: 0 to 284 degrees F (0 to 140 degrees C) liquid or 25 psig (172.4 kPa) steam.
 - 2) Ambient Side: From minus 4 to 122 degrees F (minus 20 to 50 degrees C).
- 8. Actuator Requirements:
 - a. Assembly: Factory-mounted.
 - b. Input: 0 to 5 VDC configured for proportional control.
 - c. Accessories: Provide with valve position indicator and manual override.
- B. Globe Pattern:
 - 1. Up to 2 inches (50 mm): Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
 - 2. Over 2 inches (50 mm): Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
 - 3. Steam Systems:
 - a. Rate for service pressure of 125 psig at 250 degrees F (860 kPa at 121 degrees C).
 - b. Replaceable plugs and seats of stainless steel. Pressure drop across any steam valve at maximum flow; as indicated on drawings.
 - c. Size for 10 psig (70 kPa) inlet pressure and 5 psig (35 kPa) pressure drop.
 - d. Valves shall have modified linear characteristics.
- C. Electronic Operators:
 - 1. Select operator for full shut off at maximum pump differential pressure.

2.04 PRESSURE INDEPENDENT VALVES AND ACTUATORS

- A. Size 2 inch (50 mm) and Smaller:
 - 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 - 2. Metal construction materials consist of bronze or brass.
 - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- B. Actuator Requirements:
 - 1. Assembly: Factory-mounted.
 - 2. Input: 0 to 10 VDC configured for proportional control.
 - 3. Accessories: Provide with valve position indicator and manual override.

2.05 DAMPERS

A. Performance: Test in accordance with AMCA 500-D.

R23.00331.00

ree School DistrictGreenwood Lake UFSD - 2023 CIPInstrumentation and Control Devices for HVAC230913 - 4

- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gauge, 0.1046 inch (2.66 mm).
- C. Blades: Galvanized steel, maximum blade size 8 inches (200 mm) wide, 48 inches (1200 mm) long, minimum 22 gauge, 0.0299 inch (0.76 mm), attached to minimum 1/2 inch (13 mm) shafts with set screws.
- D. Blade Seals: Synthetic elastomeric, inflatable, mechanically attached, field replaceable.
- E. Shaft Bearings: Oil impregnated sintered bronze.
- F. Linkage Bearings: Oil impregnated sintered bronze.
- G. Leakage: Less than one percent based on approach velocity of 2000 ft per min (10 m per sec) and 4 inches wg (1.0 kPa).
- H. Maximum Pressure Differential: 6 inches wg (1.5 kPa).
- I. Temperature Limits: Minus 40 to 200 degrees F (Minus 40 to 93 degrees C).

2.06 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 36 sq ft (3.34 sq m) damper section.
- B. Electric Operators:
 - 1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

2.07 INPUT/OUTPUT SENSORS

- A. Temperature Sensors:
 - 1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 - 2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F (26 degrees C).
 - 3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 4. Temperature Sensing Device: Compatible with project DDC controllers.
 - 5. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
 - 4) All Other Accuracy: Plus/minus 0.75 degrees F (0.42 degrees C) minimum.
 - 5) Range: Minus 40 degrees F (Minus 40 degrees C) through 220 degrees F (104.4 degrees C) minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F (0.20 degrees C) minimum.
 - 2) Range: Minus 25 degrees F (Minus 13 degrees C) through 122 degrees F (50 degrees C) minimum.

R23.00331.00

Instrumentation and Control Devices for HVAC

Greenwood Lake UFSD - 2023 CIP VAC 230913 - 5

- 3) Heat Dissipation Constant: 2.7 mW per degree C.
- c. Room Sensors: Locking cover.
- d. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
- e. Room Temperature Sensors with Integral Digital Display:
 - 1) Construct for wall box.
- f. Temperature Averaging Elements:
 - 1) Use on duct sensors for ductwork 10 sq ft (0.93 sq m) or larger.
 - 2) Provide for all mixed air and heating coil discharge sensors regardless of duct size.
- g. Insertion Elements:
 - 1) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches (60 mm).
- B. Humidity Sensors:
 - 1. Duct Mounted Sensor: Voltage type encased in a die-cast metal, weather-proof housing.
 - a. Input Power, Voltage Type: Class 2; 12-30 VDC/24 VAC, 15mA max.
 - b. Input Power, mA Type: Class 2; Loop powered 12-30 VDC only, 30 mA max.
 - c. Output Voltage Type: 3-wire observed polarity.
 - d. Output mA Type: 2-wire, not polarity sensitive (clipped and capped).
 - e. Humidity:
 - 1) HS Element: Digitally profiled thin-film capacitive.
 - 2) Accuracy 1 percent at 10 to 80 percent relative humidity at 77 degrees F (25 degrees C), multi-point calibration, NIST traceable.
 - (a) Plus/minus 1 percent at 20 to 40 percent RH in mA output mode; (multipoint calibration, NIST traceable).
 - 3) Scaling: 0 to 100 percent RH.
 - f. Temperature Effect:
 - 1) Duct Mounted: Plus/minus 0.18 percent per degree F (Plus/minus 0.10 percent per degree C).
 - 2) Outdoor Mounted: 4 to 20mA version: (0.0013x%RHx(TdegreeC-25)).
 - g. Hysteresis: 1.5 percent typical.
 - h. Linearity: Included in accuracy specification.
 - i. Reset Rate: 24 hours.
 - j. Stability: Plus/minus 1 percent at 68 degrees F (20 degrees C) annually, for two years.
 - k. Temperature Monitoring:
 - 1) Temperature Transmitter Output: Digital, 4 to 20mA (clipped and capped) or 0-5V/0-10V output.
 - (a) HO Transmitter Accuracy: Plus/minus 2.3 degrees F (Plus/minus 1.3 degrees C).
 - (b) HD Transmitter Accuracy: Plus/minus 1.0 degree F (Plus/minus 0.5 degrees C).
 - I. Operating Environment:
 - 1) Operating Humidity Range: 0 to 100 percent RH noncondensing.
 - 2) Operating Temperature Range: Minus 40 degrees F (Minus 40 degrees C) to 122 degrees F (50 degrees C).
- C. Static Pressure (Air Pressure) Sensors:

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Instrumentation and Control Devices for HVAC

230913 - 6

- 1. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
- 2. Accuracy: One percent of full scale with repeatability 0.3 percent.
- Output: 0 to 5 vdc with power at 12 to 28 vdc. 3.
- D. Equipment Operation (Current) Sensors:
 - Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches 1. wg (0 to 1250 Pa).
 - Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable 2. pressure differential range of 8 to 60 psi (50 to 400 kPa).
 - Status Inputs for Electric Motors: Current sensing relay with current transformers, 3. adjustable and set to 175 percent of rated motor current.

PART 3 EXECUTION

3.01 EXAMINATION

- Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- Sequence work to ensure installation of components is complementary to installation of similar D. components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- Ensure installation of components is complementary to installation of similar components. F.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- Check and verify location of exposed control sensors with plans and room details before B. installation. Locate 60 inches (1500 mm) above floor. Align with lighting switches. Refer to Section 262726.
- C. Mount freeze protection thermostats using flanges and element holders.
- D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- Provide separable sockets for liquids and flanges for air bulb elements. E.
- F. Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot G. positioners on mixed air damper motors.
- Provide isolation (two position) dampers of parallel blade construction. H.
- Install damper motors on outside of duct in warm areas. Do not install motors in locations at Ι. outdoor temperatures.
- Mount control panels adjacent to associated equipment on vibration free walls or free standing J. angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

R23.00331.00

ree School DistrictGreenwood Lake UFSD - 2023 CIPInstrumentation and Control Devices for HVAC230913 - 7

- K. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- L. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MAINTENANCE

- A. See Section 017000 Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- C. Provide complete service of controls systems, including call backs, and submit written report of each service call.
- D. In addition to normal service calls, make minimum of 4 complete normal inspections of approximately 4 hours duration to inspect, calibrate, and adjust controls.

END OF SECTION 230913

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Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 1

R23.00331.00

SECTION 230923 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. System description.
- B. Operator interface.
- C. Controllers.
- D. Power supplies and line filtering.
- E. System software.
- F. Controller software.
- G. HVAC control programs.

1.02 RELATED REQUIREMENTS

- A. Section 230913 Instrumentation and Control Devices for HVAC.
- B. Section 230993 Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).
- B. MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests; 2019h.
- C. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 - 3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 4. Indicate description and sequence of operation of operating, user, and application software.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E. Operation and Maintenance Data:
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.

R23.00331.00

Direct-Digital Control System for HVAC

- 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
- 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum 5 years of documented experience.
- D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.06 WARRANTY

- A. See Section 017800 Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.
- C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Johnson Controls, Inc; _____: www.johnsoncontrols.com/#sle.
- B. Schneider Electric; _____: www.schneider-electric.us/#sle.
- C. Siemens AG, Building Technologies Division; _____: www.siemens.com/#sle.

2.02 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 230913.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.03 OPERATOR INTERFACE

A. PC Based Work Station:

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 3

- 1. Resides on high speed network with building controllers.
- 2. Connected to server for full access to all system information.
- B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
- C. BACnet protocol to comply with ASHRAE Std 135.
- D. Hardware:
 - Desktop: 1.
 - a. Computer(s) and display(s) to be provided by DDC controls manufacturer.
 - b. Quantity: As indicated on the drawings.
 - c. Minimum RAM:
 - d. Minimum Processing Speed: _____.
 - e. Minimum Hard Drive Memory: _____.
 - Drives: _____. f.
 - Ports: _____. Monitor: _____. g.
 - h.
 - Location(s): As indicated on the drawings. i.
 - Network Connection: j.
 - 1) Ethernet interface card.
 - Minimum Speed: . 2)
 - System Printer: k.
 - 1) Printer(s) to be provided by DDC controls manufacturer.
 - 2) Quantity: As indicated on the drawings.
 - 3) Type:
 - 4) Resolution:
 - Minimum Print Speed: 5)
 - 6) Locations(s): As indicated on the drawings.
 - 2. Laptop:
 - a. Laptop(s) to be provided by DDC controls manufacturer.
 - b. Quantity: As indicated on the drawings.
 - c. Minimum RAM:
 - d. Minimum Processing Speed: _____.
 - e. Minimum Hard Drive Memory: _____.
 - f. Drives: _____.
 - g. Ports: _____.
 - h. Display:
 - Network Connection: i.
 - 1) Ethernet interface card.
 - 2) Minimum Speed: _____.

2.04 CONTROLLERS

- A. Building Controllers:
 - 1. General:
 - Manage global strategies by one or more, independent, standalone, microprocessor a. based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP C 230923 - 4

		 Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms 	
		e. Utilize real-time clock for scheduling.	
		f. Continuously check processor status and memory circuits for abnormal operation.	
		 Generation of abnormal operation. 	
		h. Communication with other network devices to be based on assigned protocol.	
	2.	Communication:	
		 Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical laver protocol. 	
		 Perform routing when connected to a network of custom application and application specific controllers. 	٦
		c. Provide service communication port for connection to a portable operator's termina or hand held device with compatible protocol.	I
	3.	Anticipated Environmental Ambient Conditions:	
		a. Outdoors and/or in Wet Ambient Conditions:	
		1) Mount within waterproof enclosures.	
		2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).	
		b. Conditioned Space:	
		 Mount within dustproof enclosures. 	
		2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).	
	4.	Provisions for Serviceability:	
		a. Diagnostic LEDs for power, communication, and processor.	
		 Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable. 	
	5.	Memory: In the event of a power loss, maintain all BIOS and programming information	for
		a minimum of 72 hours.	
	6.	Power and Noise Immunity:	
		a. Maintain operation at 90 to 110 percent of nominal voltage rating.	
		b. Perform orderly shutdown below 80 percent of nominal voltage.	
		c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios t to 5 W. at 3 feet (1 m).	ıp
В.	Cus	stom Application Controller:	
1. General:		General:	
		a. Provide sufficient memory to support controller's operating system, database, and programming requirements.	
		b. Share data between networked, microprocessor based controllers.	
		 Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for control monitoring and alarma 	
		anowing for central monitoring and alarms.	
		e Continuously check processor status and memory circuits for abnormal operation	
		 f. Controller to assume predetermined failure mode and generate alarm notification 	
		a Communication with other network devices to be based on assigned protocol	
	2	g. Communication with other network devices to be based on assigned protocol.	
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R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 5

- a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
- b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
- 4. Provisions for Serviceability:
 - a. Diagnostic LED's for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet (1 m).
- C. Application Specific Controllers:
 - 1. General:
 - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
 - 2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 6

- a. Maintain operation at 90 to 110 percent of nominal voltage rating.
- b. Perform orderly shutdown below 80 percent of nominal voltage.
- c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet (1 m).
- D. Input/Output Interface:
 - 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
 - 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
 - 4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
 - 5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
 - 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
 - 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
 - 8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
 - 9. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.

R23.00331.00

Direct-Digital Control System for HVAC

b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.05 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies:
 - 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
 - 2. Limit connected loads to 80 percent of rated capacity.
 - 3. Match DC power supply to current output and voltage requirements.
 - 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
 - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
 - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
 - 7. Operational Ambient Conditions: 32 to 120 degrees F (0 to 50 degrees C).
 - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
 - 9. Line voltage units UL recognized and CSA approved.
- B. Power Line Filtering:
 - 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
 - 2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.06 SYSTEM SOFTWARE

3.

- A. Operating System:
 - 1. Concurrent, multi-tasking capability.
 - a. Common Software Applications Supported: Microsoft Excel.
 - b. Acceptable Operating Systems: _____.
 - 2. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:
 - (a) Analog and binary values.
 - (b) Dynamic text.
 - (c) Static text.
 - (d) Animation files.
 - Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics in PCX formats.
 - b. HTML graphics to support web browser compatible formats.

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 8

- c. Capture or convert graphics from AutoCAD.
- 4. Standard HVAC Graphics Library:
 - a. HVAC Equipment:
 - 1) Boilers.
 - 2) Air Handlers.
 - 3) Terminal HVAC Units.
 - 4) Fan Coil Units.
 - Unit Ventilators.
 - b. Ancillary Equipment:
 - 1) Fans.
 - 2) Pumps.
 - 3) Coils.
 - 4) Valves.
 - 5) Piping.
 - 6) Dampers.
 - 7) Ductwork.
- B. Workstation System Applications:
 - 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on hard disk.
 - b. Automatic update occurs upon change in any system panel.
 - c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.
 - 3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
 - 4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
 - 5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during useradjustable, time period.
 - f. All system security data stored in encrypted format.
 - 6. System Diagnostics:
 - a. Operations Automatically Monitored:
R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 9

- 1) Workstations.
- 2) Printers.
- 3) Modems.
- 4) Network connections.
- 5) Building management panels.
- 6) Controllers.
- b. Device failure is annunciated to the operator.
- 7. Alarm Processing:

b.

- a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
- 8. Alarm Messages:
 - a. Descriptor: English language.
 - b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
- 9. Configurable Alarm Reactions by Workstation and Time of Day:
 - a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
- 10. Custom Trend Logs:
 - a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Archivable on hard disk.
 - 3) Retrievable for use in reports, spreadsheets and standard database programs.
 - 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
 - 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
- 11. Alarm and Event Log:
 - a. View all system alarms and change of states from any system location.
 - b. Events listed chronologically.
 - c. Operator with proper security acknowledges and clears alarms.
 - d. Alarms not cleared by operator are archived to the workstation hard disk.
- 12. Object, Property Status and Control:

R23.00331.00

Direct-Digital Control System for HVAC

- a. Provide a method to view, edit if applicable, the status of any object and property in the system.
- b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
- 13. Reports and Logs:
 - a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
 - b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
 - c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - d. Set to be printed on operator command or specific time(s).
- 14. Reports:
 - a. Standard:
 - 1) Objects with current values.
 - 2) Current alarms not locked out.
 - 3) Disabled and overridden objects, points and SNVTs.
 - 4) Objects in manual or automatic alarm lockout.
 - 5) Objects in alarm lockout currently in alarm.
 - 6) Logs:
 - (a) Alarm History.
 - (b) System messages.
 - (c) System events.
 - (d) Trends.
 - b. Custom:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - c. Tenant Override:
 - 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
 - 2) Annual report showing override usage on a monthly basis.
 - d. Electrical, Fuel, and Weather:
 - 1) Electrical Meter(s):
 - (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
 - (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
 - 2) Fuel Meter(s):
 - (a) Monthly showing daily natural gas consumption for each meter.

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 11

- (b) Annual summary showing monthly consumption for each meter.
- 3) Weather:
 - (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- C. Workstation Applications Editors:
 - 1. Provide editing software for each system application at PC workstation.
 - 2. Downloaded application is executed at controller panel.
 - 3. Full screen editor for each application allows operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
 - 4. Scheduling:
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be scheduled and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
 - 5. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
 - Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
 - 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
 - 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
 - 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
 - 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.
 - 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.07 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 12

- 1. User access secured via user passwords and user names.
- 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
- 3. User Log On/Log Off attempts are recorded.
- 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 - 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
 - 2. Holiday or Special Schedules:
 - a. Capability to define up to 99 schedules.
 - b. Repeated annually.
 - c. Length of each period is operator defined.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
 - 1. Binary object is set to alarm based on the operator specified state.
 - 2. Analog object to have high/low alarm limits.
 - 3. All alarming is capable of being automatically and manually disabled.
 - 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation in Section 230993.
- H. PID Control Characteristics:
 - 1. Direct or reverse action.
 - 2. Anti-windup.
 - 3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
 - 4. User selectable controlled variable, set-point, and PED gains.
- I. Staggered Start Application:
 - 1. Prevents all controlled equipment from simultaneously restarting after power outage.
 - 2. Order of equipment startup is user selectable.
- J. Energy Calculations:
 - 1. Accumulated instantaneous power or flow rates are converted to energy use data.
 - 2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
 - 3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- K. Anti-Short Cycling:
 - 1. All binary output objects protected from short-cycling.
 - 2. Allows minimum on-time and off-time to be selected.

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 13

- L. On-Off Control with Differential:
 - 1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 - 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- M. Run-Time Totalization:
 - 1. Totalize run-times for all binary input objects.
 - 2. Provides operator with capability to assign high run-time alarm.

2.08 HVAC CONTROL PROGRAMS

- A. Optimal Run Time:
 - 1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
 - 2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room temperature.
 - 3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
 - 4. Use outside air temperature to determine early shut down with ventilation override.
 - 5. Control Summary:
 - a. HVAC Control system begin/end status.
 - b. Optimal run time lock/unlock control status.
 - c. Heating/cooling mode status.
 - d. Optimal run time schedule.
 - e. Start/Stop times.
 - f. Occupancy and vacancy times.
 - 6. HVAC point summary:
 - a. Control system identifier and status.
 - b. Point ID and status.
 - c. Outside air temperature point ID and status.
 - d. Calculated optimal start and stop times.
- B. Supply Air Reset:
 - 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, and single zone unit discharge temperatures.
 - 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
 - a. Raising cooling temperatures to highest possible value.
 - b. Reducing heating temperatures to lowest possible level.
 - 3. Control summary:
 - a. HVAC control system status (begin/end).
 - b. Supply air reset system status.
 - c. Optimal run time system status.
 - d. High/low limits.
 - e. Deadband.
- C. Enthalpy Switchover:
 - 1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
 - 2. Operator commands:
 - a. Add/delete fan status point.
 - b. Add/delete outside air temperature point.

R23.00331.00

Direct-Digital Control System for HVAC

Greenwood Lake UFSD - 2023 CIP 230923 - 14

- c. Add/delete discharge controller point.
- d. Define discharge controller parameters.
- e. Add/delete return air temperature point.
- f. Add/delete outside air dew point/humidity point.
- g. Add/delete return air dew point/humidity point.
- h. Add/delete damper switch.
- i. Add/delete minimum outside air.
- j. Add/delete heating override switch.
- k. Add/delete air flow rate.
- I. Define enthalpy deadband.
- m. Request HVAC point summary.
- 3. Control summary:
 - a. HVAC control system begin/end status.
 - b. Enthalpy switchover optimal system status.
 - c. Optimal return time system status.
 - d. Current outside air enthalpy.
 - e. Calculated mixed air enthalpy.
 - f. Calculated cooling cool enthalpy using outside air.
 - g. Calculated cooling cool enthalpy using mixed air.
 - h. Calculated enthalpy difference.
 - i. Enthalpy switchover deadband.
 - j. Status of damper mode switch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 230993.
- C. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.
- C. Provide basic operator training for 4 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

R23.00331.00

3.04 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate complete and operating system to Owner.

3.05 MAINTENANCE

- A. See Section 017000 Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
- C. Provide four complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
- D. Provide complete service of systems, including call backs. Make minimum of 4 complete normal inspections of approximately 4 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

END OF SECTION 230923

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R23.00331.00

Greenwood Lake UFSD - 2023 CIP SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

230993 - 1

SECTION 230993 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems and equipment.

1.02 DEFINITIONS

- A. DDC: Direct digital control.
- B. BAS: Building automation system; EMS: Energy management system.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 HVAC CONTROL SEQUENCES

3.02 GENERAL

- A. All set points, changeover points and reset schedules shall be user adjustable.
- B. Control algorithms shall utilize tuned PID loops to maintain set points and minimum/maximum leaving air temperatures optimally.
- C. Coordinate individual alarm notifications with Owner.
- D. Alarms shall be configured as status only or critical. Status only alarms shall display alarm on the Owner coordinated workstation(s) and device(s). Critical alarms shall incorporate coordinated unit shutdown along with displaying alarms on the Owner coordinated devices and require the alarm to be cleared prior to restarting the equipment.
- E. All HVAC equipment shall operate in occupied/unoccupied modes as determined by the DDC building time clock system. Obtain the building occupancy schedule from the Owner.
- All equipment shall utilize optimum start/stop programs. F.
- G. Assign all equipment a stagger start number to keep to many units from starting at the same time. In effect, this flattens load peaks. This includes start-up on emergency power.
- H. Unoccupied override buttons shall place the space equipment in occupied mode for a period of one-hour (adjustable).
- Coordinate chilled water valve and chilled water pump response time with the chiller ١. manufacturer's maximum rate of change in chilled water flow.

3.03 UNIVERSAL SET POINTS. UNLESS OTHERWISE NOTED, USE THE FOLLOWING SPACE TEMPERATURE SET POINTS. SET POINTS SHALL BE INDEPENDENTLY ADJUSTABLE BY SPACE THROUGH THE BMS.

	Occupied Modes		Unoccup	Unoccupied Modes	
	Cooling	Heating	Cooling	Heating	
Occupied Spaces	74°F	69°F	85°F	55°F	
Unoccupied Spaces	80°F	60°F	85°F	55°F	

3.04 GENERAL EXHAUST FANS CONSTANT SPEED

A. Occupied Mode

1. Enable fan at all times.

R23.00331.00

e School District Greenwood Lake UFSD - 2023 CIP SEQUENCE OF OPERATIONS FOR HVAC

230993 - 2

CONTROLS

- B. Unoccupied Mode
 - 1. Disable fan at all times.
- C. Alarms
 - 1. Fan start failure.
 - 2. Fan stop failure.

3.05 ELECTRIC CABINET UNIT HEATERS

- A. Enable and disable fan as necessary to maintain space temperature heating set point.
- B. Alarms
 - 1. Fan start/stop failure
 - 2. Space temperature high/low limits.

3.06 CHILLED WATER SYSTEM

- A. Enable the chilled water system when the outside air temperature is above 65-degrees and the system is operating in cooling season as defined by the Owner.
 - 1. Building chilled water pumps
 - a. Enable pumps utilizing the lead/standby pump sequence outlined below.
 - b. Modulate the lead pump to maintain the pressure differential set point as determined by the balancer.
 - c. If any associated control valve opens to 90%, modulate the pump speed up to compensate.
 - d. Alarms
 - 1) Equipment failure.
 - 2) VFD Alarm.
 - 3) High/low building supply pressure.
 - 2. Adiabatic cooler pumps
 - a. Enable pumps utilizing the lead/standby pump sequence outlined below.
 - b. Alarms
 - 1) Equipment failure.
 - 2) VFD Alarm.
 - 3. Adiabatic Cooler
 - a. Enable
 - b. Provide BMS notification of alarm condition
 - 4. Chiller
 - a. Enable chiller.
 - b. Provide leaving chilled water temperature set point to chiller control panel based on outside air reset schedule below

Building Supply Water Reset					
	Buil	Building Supply Water			
OAT	Occupied Modes	Unoccupied Modes			
85°F	42°F	45°F			
75°F	45°F	45°F			

- 1) Utilize optimum start program to reach the above temperatures five-minutes prior to any building equipment cool down or unoccupied mode.
- c. Alarms

R23.00331.00

Greenwood Lake UFSD - 2023 CIP SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

230993 - 3

- Chiller alarm. 1)
- 2) High/low condenser water temperatures.
- High/low building supply temperature. 3)
- Glycol Makeup Unit 5.
 - Alarm: Provide BMS notification of alarm condition. a.

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Greenwood Lake Union Free School District R23.00331.00 Hvdror

Greenwood Lake UFSD - 2023 CIP 232113 - 1

Hydronic Piping

SECTION 232113 HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Heating water and glycol piping, above grade.
- D. Chilled water piping, above grade.
- E. Equipment drains and overflows.
- F. Pipe hangers and supports.
- G. Unions, flanges, mechanical couplings, and dielectric connections.
- H. Valves:
 - 1. Ball valves.
 - 2. Butterfly valves.
- I. Flow controls.

1.02 RELATED REQUIREMENTS

- A. Section 230516 Expansion Fittings and Loops for HVAC Piping.
- B. Section 230719 HVAC Piping Insulation-CPL.
- C. Section 232500 HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ASME BPVC-IX Boiler and Pressure Vessel Code, Section IX Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- B. ASME B16.3 Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- C. ASME B16.15 Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2018.
- D. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.22 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- F. ASME B31.9 Building Services Piping; 2020.
- G. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- H. ASTM A106/A106M Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2019a.
- I. ASTM A183 Standard Specification for Carbon Steel Track Bolts and Nuts; 2014 (Reapproved 2020).
- J. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- K. ASTM A536 Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- L. ASTM B32 Standard Specification for Solder Metal; 2020.

- M. ASTM B88 Standard Specification for Seamless Copper Water Tube; 2020.
- N. ASTM B88M Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications; 2018.
- P. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- Q. ASTM F1476 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
- R. AWS D1.1/D1.1M Structural Welding Code Steel; 2015, with Errata (2016).
- S. AWWA C606 Grooved and Shouldered Joints; 2015.
- T. MSS SP-58 Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalog information.

1.05 QUALITY ASSURANCE

A. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
 - b. Grooved mechanical connections and joints comply with AWWA C606.
 - 1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
 - 2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
 - c. Use rigid joints unless otherwise indicated.

R23.00331.00)	Hydronic Piping	232113 - 3
	d.	Use gaskets of molded synthetic rubber with configuration, and complying with ASTM D2 circulating medium up to maximum 230 deg M3BA610A15B44Z for circulating medium u degrees C).	a central cavity, pressure-responsive 000, Grade 2CA615A15B44F17Z for rees F (110 degrees C) or Grade p to maximum 200 degrees F (93
	e.	Provide steel coupling nuts and bolts comply	/ing with ASTM A183.
4	Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unles		

- accordance with ASME B3 indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
 - Where grooved joints are used in piping, provide grooved valve/equipment connections if 1. available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
 - Provide drain valves where indicated, and if not indicated, provide at least at main shut-1 off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.
 - For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves. 2.
 - For throttling service, use plug cocks. Use non-lubricated plug cocks only when shut-off 3. or isolating valves are also provided.
- E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.02 HEATING WATER PIPING, ABOVE GRADE

- Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types: Α.
 - Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M 1. welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 - Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical 3. couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittinas.
 - Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver. а
 - Tee Connections: Mechanically extracted collars with notched and dimpled branch tube. 2.

2.03 CHILLED WATER PIPING, ABOVE GRADE

- Α. Steel Pipe Sizes 12 Inches (305 mm) and Greater: ASTM A53/A53M, 3/8 inch (9.5 mm) wall, black; using one of the following joint types:
 - Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS 1. D1.1/D1.1M welded.
 - 2 Threaded Joints: ASTM A536 ductile iron fittings.
 - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

2.04 EQUIPMENT DRAINS AND OVERFLOWS

- Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types: Α
 - Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings. 1.

Greenwood Lake Union Free School District

Greenwood Lake UESD - 2023 CIP

- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.05 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. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Adjustable steel yoke, cast iron roll, double hanger.
 - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Vertical Support: Steel riser clamp.
 - 9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 10. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 12. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 13. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 2 Inches (50 mm) and Less:
 - 1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
 - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches (50 mm) and Greater:
 - 1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
 - 2. Gaskets: 1/16 inch (1.6 mm) thick, preformed neoprene.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Mechanical Couplings: Comply with ASTM F1476.
 - 3. Housing Material: Ductile iron, galvanized complying with ASTM A536.

R23.00331.00

Hydronic Piping

Greenwood Lake UFSD - 2023 CIP 232113 - 5

- 4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
- 5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
- 6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- 7. Manufacturers:
 - a. Apollo Valves; _____: www.apollovalves.com/#sle.
 - b. Grinnell Products; _____: www.grinnell.com/#sle.
 - c. Victaulic Company; _____: www.victaulic.com/#sle.
- D. Dielectric Connections:
 - 1. Waterways:
 - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - b. Dry insulation barrier able to withstand 600-volt breakdown test.
 - c. Construct of galvanized steel with threaded end connections to match connecting piping.
 - d. Suitable for the required operating pressures and temperatures.
 - 2. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600-volt breakdown test.
 - d. Construct of galvanized steel with threaded end connections to match connecting piping.
 - e. Suitable for the required operating pressures and temperatures.
 - 3. Unions:
 - a. 1/2 to 1 Inches (15 to 25 mm): Brass solder to galvanized FPT.
 - b. 1/2 to 2 Inches (15 to 50 mm): Brass solder to galvanized FPT.
 - c. 1/2 to 1 Inches (15 to 25 mm): Brass to galvanized FPT or FIP (Female Iron Pipe).
 - d. 3/4 to 1/2 Inch (20 to 15 mm) Reducer: Brass solder to galvanized FPT.
 - e. Service: 250 psi (1,723.6 kPa), minus 20 to 180 deg F (minus 28.9 to 82.2 deg F).

2.07 BALL VALVES

- A. Manufacturers:
 - 1. Anvil International: www.anvilintl.com/#sle.
 - 2. Apollo Valves: www.apollovalves.com/#sle.
 - 3. Grinnell Products: www.grinnell.com/#sle.
 - 4. Shurjoint Piping Products, Inc: www.shurjoint.com/#sle.
 - 5. Victaulic Company: www.victaulic.com/#sle.
 - 6. Viega LLC: www.viega.us/#sle.
 - 7. Substitutions: See Section 016000 Product Requirements.
- B. Up To and Including 2 Inches (50 mm):
 - 1. Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, threaded ends with union.
- C. Over 2 Inches (50 mm):
 - 1. Ductile iron body, chrome plated stainless steel ball, teflon or Virgin TFE seat and stuffing box seals, lever handle or gear operated, flanged ends, rated to 800 psi (5515 kPa).

R23.00331.00

Hydronic Piping

Greenwood Lake UFSD - 2023 CIP 232113 - 6

2.08 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Anvil International: www.anvilintl.com/#sle.
 - 2. Apollo Valves: www.apollovalves.com/#sle.
 - 3. Grinnell Products: www.grinnell.com/#sle.
 - 4. Shurjoint Piping Products, Inc: www.shurjoint.com/#sle.
 - 5. Victaulic Company: www.victaulic.com/#sle.
 - 6. Substitutions: See Section 016000 Product Requirements.
- B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, grooved, or _____ ends, extended neck.
- C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, Buna-N encapsulation, or ______.
- D. Stem: Stainless steel with stem offset from the centerline to provide full 360-degree circumferential setting.
- E. Operator: 10 position lever handle.

2.09 FLOW CONTROLS

- A. Manufacturers:
 - 1. Griswold Controls: www.griswoldcontrols.com/#sle.
 - 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 - 3. Taco, Inc: www.taco-hvac.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi (13.7 kPa).

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Section 232500 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and to avoid interference with use of space.
- D. Group piping whenever practical at common elevations.

R23.00331.00

Hydronic Piping

Greenwood Lake UFSD - 2023 CIP 232113 - 7

- E. Sleeve pipe passing through partitions, walls, and floors.
- F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified ______.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 230516.
- I. Grooved Joints:
 - 1. Install in accordance with the manufacturer's latest published installation instructions.
 - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- J. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2-inch (13 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inches (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide copper plated hangers and supports for copper piping.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 230719.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- M. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 Inch (15 mm) and 3/4 inch (20 mm): Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6 mm).
 - 2. 1 Inch (25 mm): Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6 mm).
 - 3. 1-1/2 Inches (40 mm) and 2 Inches (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
- B. Hanger Spacing for Steel Piping.
 - 1. 2-1/2 Inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9 mm).
 - 2. 3 Inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9 mm).
 - 3. 4 Inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
 - 4. 6 Inches (150 mm): Maximum span, 17 feet (5.1 m); minimum rod size, 1/2 inch (13 mm).
 - 5. 8 Inches (200 mm): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).

END OF SECTION 232113

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R23.00331.00

Hydronic Specialties

Greenwood Lake UFSD - 2023 CIP 232114 - 1

SECTION 232114 HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air vents.
- B. Strainers.
- C. Pressure-temperature test plugs.
- D. Balancing valves.

1.02 RELATED REQUIREMENTS

A. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 AIR VENTS

- A. Manual Type: Short vertical sections of 2-inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.
- B. Float Type:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- C. Washer Type:
 - 1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.02 STRAINERS

A. Manufacturers:

R23.00331.00

Hydronic Specialties

Greenwood Lake UFSD - 2023 CIP 232114 - 2

- 1. Armstrong International, Inc: www.armstronginternational.com/#sle.
- 2. Flexicraft Industries: www.flexicraft.com/#sle.
- 3. Grinnell Products: www.grinnell.com/#sle.
- B. Size 2 inch (50 mm) and Under:
 - 1. Screwed brass or iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- C. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):
 - 1. Provide flanged or grooved iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/16 inch (1.6 mm) or 3/64 inch (1.2 mm) stainless steel perforated screen.
- D. Size 5 inch (125 mm) and Larger:
 - 1. Provide flanged or grooved iron body for 175 psi (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

2.03 PRESSURE-TEMPERATURE TEST PLUGS

- A. Manufacturers:
 - 1. Ferguson Enterprises Inc: www.fnw.com/#sle.
 - 2. Peterson Equipment Company Inc: www.petesplug.com/#sle.
 - 3. Sisco Manufacturing Company Inc: www.siscomfg.com/#sle.
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F (93 degrees C).
- C. Application: Use extended length plugs to clear insulated piping.

2.04 BALANCING VALVES

- A. Manufacturers:
 - 1. Armstrong International, Inc: www.armstronginternational.com/#sle.
 - 2. Ferguson Enterprises Inc: www.fnw.com/#sle.
 - 3. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.
 - 4. ITT Bell & Gossett: www.bellgossett.com/#sle.
 - 5. Taco, Inc: www.taco-hvac.com/#sle.
- B. Size 2 inch (50 mm) and Smaller:
 - 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
 - 2. Metal construction materials consist of bronze or brass.
 - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- C. Size 2.5 inch (64 mm) and Larger:
 - 1. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged, grooved, or weld end connections.
 - 2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
 - 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.

PART 3 EXECUTION

3.01 INSTALLATION

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

- B. Provide manual air vents at system high points and as indicated.
- C. Provide manual air vents in ceiling spaces and other concealed location
- D. Provide automatic air vents in exposed locations and in mechanical rooms.
- E. Provide valved drain and hose connection on strainer blowdown connection.

END OF SECTION 232114

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HVAC Ducts and Casings

Greenwood Lake UFSD - 2023 CIP 233100 - 1

SECTION 233100 HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.
- C. Duct cleaning.

1.02 RELATED REQUIREMENTS

- A. Section 230593 Testing, Adjusting, and Balancing for HVAC-CPL.
- B. Section 230713 Duct Insulation-CPL: External insulation and duct liner.
- C. Section 233300 Air Duct Accessories.
- D. Section 233600 Air Terminal Units.
- E. Section 233700 Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

- A. ASHRAE (FUND) ASHRAE Handbook Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A36/A36M Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- D. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- F. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B209M Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- H. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- I. ICC-ES AC01 Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- J. ICC-ES AC106 Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.
- K. ICC-ES AC193 Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- L. ICC-ES AC308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- M. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- N. SMACNA (DCS) HVAC Duct Construction Standards Metal and Flexible; 2021.
- O. SMACNA (LEAK) HVAC Air Duct Leakage Test Manual; 2012.

R23.00331.00

HVAC Ducts and Casings

Greenwood Lake UFSD - 2023 CIP 233100 - 2

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for ______ pressure class and higher systems.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. General Exhaust: 1 inch wg (250 Pa) pressure class, galvanized steel.
- D. Transfer Air and Sound Boots: 1/2 inch wg (125 Pa) pressure class, galvanized steel.

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.
- C. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- D. Stainless Steel for Ducts: ASTM A666, Type 304.
- E. 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 index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 - 4. Manufacturers:
 - a. Carlisle HVAC Products; Hardcast Versa-Grip 181 Water Based Fiber Reinforced Duct Sealant: www.carlislehvac.com/#sle.
 - b. Design Polymerics; DP 1010 Water Based Smooth Duct Sealant, Zero VOC, Premium Quality: www.designpoly.com/#sle.
 - c. Ductmate Industries, Inc, a DMI Company; _____: www.ductmate.com/#sle.
- F. Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle rings connections.
- G. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- H. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

R23.00331.00

HVAC Ducts and Casings

Greenwood Lake UFSD - 2023 CIP 233100 - 3

- 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
- 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
- 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
- 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
- 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
- 6. Other Types: As required.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) 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 (FUND) Handbook Fundamentals.
- C. Duct systems have been designed for metal duct. At the Contractor's option, fibrous glass duct may be substituted for metal duct.
- D. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- E. 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 of perforated metal with glass fiber insulation.
- F. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- H. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Round Ducts: Round lockseam duct with galvanized steel outer wall.
 1. Manufacture in accordance with SMACNA (DCS).
- B. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 - 2. Pressure Rating: 10 inches wg (2.50 kPa) positive and 1.0 inches wg (250 Pa) negative.
 - 3. Maximum Velocity: 4000 fpm (20.3 m/sec).
 - 4. Temperature Range: Minus 10 degrees F to 160 degrees F (Minus 23 degrees C to 71 degrees C).
- C. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
- D. Round Duct Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.

- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Flexible Ducts: Connect to metal ducts with adhesive.
- E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- F. 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.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.
- K. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

3.02 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION 233100

R23.00331.00

Air Duct Accessories

Greenwood Lake UFSD - 2023 CIP 233300 - 1

SECTION 233300 AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Combination fire and smoke dampers.
- C. Combination fire and smoke dampers corridor dampers.
- D. Duct access doors.
- E. Duct test holes.
- F. Fire dampers.
- G. Flexible duct connectors.
- H. Smoke dampers.
- I. Volume control dampers.

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 233100 HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- B. NFPA 92 Standard for Smoke Control Systems; 2021.
- C. SMACNA (DCS) HVAC Duct Construction Standards Metal and Flexible; 2021.
- D. UL 555 Standard for Fire Dampers; Current Edition, Including All Revisions.
- E. UL 555S Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 Product Requirements, for additional provisions.
 - 2. Extra Fusible Links: One of each type and size.

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

R23.00331.00

Air Duct Accessories

Greenwood Lake UFSD - 2023 CIP 233300 - 2

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com/#sle.
 - 2. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 3. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle.
 - 5. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.
 - 6. Ward Industries, a brand of Hart and Cooley, Inc: www.wardind.com/#sle.
 - 7. Substitutions: See Section 016000 Product Requirements.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. NCA, a brand of Metal Industries Inc: www.ncamfg.com/#sle.
 - 3. Pottorff: www.pottorff.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch (12.7 mm) actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- G. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.03 COMBINATION FIRE AND SMOKE DAMPERS - CORRIDOR DAMPERS

- A. Manufacturers:
 - 1. Ruskin Company; _____: www.ruskin.com/#sle.
 - 2. United Enertech; _____: www.unitedenertech.com/#sle.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.

- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch (12.7 mm) actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- G. Ratings: one hour fire resistance, class 1 leakage rating.
- H. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.04 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc, a DMI Company; _____: www.ductmate.com/#sle.
 - 2. Elgen Manufacturing Company, Inc; ____: www.elgenmfg.com/#sle.
 - 3. Nailor Industries, Inc; ____: www.nailor.com/#sle.
 - 4. Ruskin Company; ____: www.ruskin.com/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.05 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.06 FIRE DAMPERS

A. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

2.07 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
 - 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com/#sle.
 - 2. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 3. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
- D. Maximum Installed Length: 14 inch (356 mm).

2.08 SMOKE DAMPERS

- A. Manufacturers:
 - 1. AireTechnologies, Inc, a DMI Company: www.airetechnologies.com/#sle.
 - 2. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.

R23.00331.00

Air Duct Accessories

Greenwood Lake UFSD - 2023 CIP 233300 - 4

- 3. Nailor Industries, Inc: www.nailor.com/#sle.
- 4. Ruskin Company: www.ruskin.com/#sle.
- 5. United Enertech: www.unitedenertech.com/#sle.
- 6. Substitutions: See Section 016000 Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 airfoil blade type smoke damper, normally closed automatically operated by electric actuator. Ratings shall be not less than 250 degrees F (121 degrees C).

2.09 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 - 2. Nailor Industries, Inc: www.nailor.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. United Enertech: www.unitedenertech.com/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Single Blade Dampers:
 - 1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
 - 2. Blade: 24 gauge, 0.0239 inch (0.61 mm), minimum.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch (1.21 mm), minimum.
- E. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch (200 by 200 mm) size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch (100 by 100 mm) for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

Greenwood Lake Union Free School District R23.00331.00 Air Duct /

- Air Duct Accessories
- F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- G. 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.
- H. Use splitter dampers only where indicated.
- I. 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

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R23.00331.00

Greenwood Lake UFSD - 2023 CIP 233423 - 1

SECTION 233423 HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof exhausters.
- B. Upblast roof exhausters.

1.02 REFERENCE STANDARDS

- A. AMCA (DIR) (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 Standards Handbook; 2016.
- C. AMCA 204 Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- E. AMCA 300 Reverberant Room Method for Sound Testing of Fans; 2014.
- F. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
- G. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.
- B. Sequencing: Ensure that utility connections are completed in an orderly and expeditious manner.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set for each individual fan.

1.05 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

- D. Fabrication: Comply with AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 ROOF EXHAUSTERS

- A. Manufacturers:
 - 1. Carnes, a division of Carnes Company Inc; _____: www.carnes.com/#sle.
 - 2. Greenheck Fan Corporation; ____: www.greenheck.com/#sle.
 - 3. Twin City Fan & Blower; BCRD: www.tcf.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 16 inch (400 mm) high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- D. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- E. Backdraft Damper: Aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.03 UPBLAST ROOF EXHAUSTERS

- A. Manufacturers:
 - 1. Carnes, a division of Carnes Company Inc; VUBK: www.carnes.com/#sle.
 - 2. Greenheck Fan Corporation; _____: www.greenheck.com/#sle.
 - 3. PennBarry, Division of Air System Components; _____: www.pennbarry.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Belt Drive Fan:
 - 1. Fan Wheel:
 - a. Type: Non-overloading, backward inclined centrifugal.
 - b. Material: Aluminum, statically and dynamically balanced.
 - 2. Housing:
 - a. Construct of heavy gauge aluminum 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. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
 - e. Provide breather tube for fresh air motor cooling and wiring.
- C. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - b. First critical speed at least 25 percent over maximum cataloged operating speed.
 - 2. Bearings:
R23.00331.00

HVAC Power Ventilators

Greenwood Lake UFSD - 2023 CIP 233423 - 3

- a. Permanently sealed or pillow block type.
- b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
- c. 100 percent factory tested.
- D. Drive Assembly:
 - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 - 2. Belts: Static free and oil resistant.
 - 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 - 4. Motor pulley adjustable for final system balancing.
 - 5. Readily accessible for maintenance.
- E. Disconnect Switches:
 - 1. Factory mounted and wired.
 - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 3. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory-applied gray unless otherwise indicated.
 - 4. Positive electrical shutoff.
 - 5. Wired from fan motor to junction box installed within motor compartment.
- F. Roof Curb: 16 inch (400 mm) high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, and factory installed nailer strip.
- G. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- H. Options/Accessories:
 - 1. Birdscreen:
 - a. Provide aluminum construction.
 - b. Protects fan discharge.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Provide sheaves required for final air balance.
- E. Install backdraft dampers on inlet to roof and wall exhausters.

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R23.00331.00

Air Outlets and Inlets

Greenwood Lake UFSD - 2023 CIP 233700 - 1

SECTION 233700 AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Diffusers:
- B. Rectangular ceiling diffusers.
- C. Registers/grilles:
 - 1. Ceiling-mounted, exhaust and return register/grilles.

1.02 REFERENCE STANDARDS

A. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (Reaffirmed 2021).

1.03 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. 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.

1.04 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carnes, a division of Carnes Company Inc; _____: www.carnes.com/#sle.
- B. Krueger-HVAC; ____: www.krueger-hvac.com/#sle.
- C. Price Industries; _____: www.price-hvac.com/#sle.
- D. Titus, a brand of Air Distribution Technologies; _____: www.titus-hvac.com/#sle.

2.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide rectangular and square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.
- B. Connections: Round.
- C. Color: As indicated.

2.03 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 1/2 inch (_____ mm) maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch (0.91 mm) minimum frames and 22 gauge, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gauge, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.

R23.00331.00

- D. Color: As indicated.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. 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.
- E. Paint ductwork visible behind air outlets and inlets matte black, see Section 099123.

Greenwood Lake UFSD - 2023 CIP ers 236313 - 1

R23.00331.00

SECTION 236313 AIR COOLED REFRIGERANT CONDENSERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured units.
- B. Casing.
- C. Condenser coils.
- D. Fan requirements.
- E. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Equipment bases.
- B. Section 230513 Common Motor Requirements for HVAC Equipment-CPL.
- C. Section 230548 Vibration and Seismic Controls for HVAC.
- D. Section 232300 Refrigerant Piping.
- E. Section 236100 Refrigerant Compressors.
- F. Section 238200 Convection Heating and Cooling Units: Air coils.
- G. Section 260583 Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. ASHRAE Std 15 Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- C. ASHRAE Std 20 Methods of Laboratory Testing Remote Mechanical-Draft Air-Cooled Refrigerant Condensers; 2019.
- D. ASHRAE Std 90.1 I-P Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NEMA MG 1 Motors and Generators; 2018.
- G. UL 207 Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical requirements, and wiring diagrams.
- C. Shop Drawings: Indicate components, assembly, dimensions, weights and loading, required clearances, and location and size of field connections. Include schematic layouts showing condenser, refrigeration compressors, cooling coils, refrigerant piping and accessories required for complete system.

R23.00331.00

Air Cooled Refrigerant Condensers

D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- B. Protect units on site from physical damage. Protect coils.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp;
 www.carrier.com/#sle.
- B. Trane, a brand of Ingersoll Rand; _____: www.trane.com/#sle.
- C. York International Corporation/Johnson Controls, Inc; _____: www.york.com/#sle.
- D. Substitutions: See Section 016000 Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Disconnect Switch: Factory mount disconnect switch in control panel.

2.03 MANUFACTURED UNITS

- A. Provide packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil liquid accumulator.
- B. Construction and Ratings: In accordance with AHRI 210/240 and UL 207. Testing shall be in accordance with ASHRAE Std 20.
- C. Performance Ratings: Energy Efficient Rating (EER)/Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1 I-P, in combination with compressor units.
- D. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

2.04 CASING

- A. House components in welded steel frame with steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
- C. Provide removable access doors or panels with quick fasteners.

2.05 CONDENSER COILS

- A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig (2900 kPa), and vacuum dehydrate. Seal with holding charge of nitrogen.
- B. Coil Guard: Expanded metal with lint screens.
- C. Configuration: Single refrigeration circuit with receiver.

R23.00331.00

2.06 FAN REQUIREMENTS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge, equipped with roller or ball bearings with grease fittings extended to outside of casing.
- B. Motors as indicated, in compliance with Section 230513.

2.07 CONTROLS

- A. Provide factory wired and mounted control panel, NEMA 250, containing fan motor starters, fan cycling thermostats, compressor interlock, and control transformer.
- B. Provide controls to permit operation down to _____ degrees F (_____ degrees C) ambient temperature.
- C. Provide thermostat to cycle fan motors in response to outdoor ambient temperature.
- D. Provide head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
- E. Provide solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
- F. Provide electronic low ambient control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. See Section 260583.
- C. Install units on vibration isolation. See Section 230548.
- D. Provide connection to refrigeration piping system. See Section 232300. Comply with ASHRAE Std 15.
- E. Provide cooling season start-up, winter season shut-down service, for first year of operation.
- F. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

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Greenwood Lake UFSD - 2023 CIP 238200 - 1

R23.00331.00

Convection Heating and Cooling Units

SECTION 238200 CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electric cabinet unit heaters.

1.02 RELATED REQUIREMENTS

- A. Section 230513 Common Motor Requirements for HVAC Equipment-CPL.
- B. Section 230719 HVAC Piping Insulation-CPL.
- C. Section 230913 Instrumentation and Control Devices for HVAC.
- D. Section 230993 Sequence of Operations for HVAC Controls.
- E. Section 232113 Hydronic Piping.
- F. Section 232114 Hydronic Specialties.
- G. Section 232300 Refrigerant Piping.
- H. Section 233100 HVAC Ducts and Casings.
- I. Section 260583 Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 350 Sound Performance Rating of Non-Ducted Indoor Air-Conditioning and Heat Pump Equipment; 2015.
- C. AHRI 410 Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- D. AHRI 840 (I-P) Performance Rating of Unit Ventilators; 2021.
- E. AHRI 841 (SI) Performance Rating of Unit Ventilators; 2021.
- F. ASHRAE (HVACA) ASHRAE Handbook HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- G. ASHRAE Std 62.1 Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SMACNA (DCS) HVAC Duct Construction Standards Metal and Flexible; 2021.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 3. 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.

- 4. Indicate mechanical and electrical service locations and requirements.
- D. Selection Samples: For each finish product specified, color chart representing manufacturer's full range of available colors.
- E. Verification Samples: For each finish product specified, color chip representing actual product in color and texture.
- F. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- G. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- H. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- I. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 Product Requirements for additional provisions.
 - 2. Extra Filters: Two sets of each type and size.

1.05 QUALITY ASSURANCE

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

1.06 WARRANTY

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

PART 2 PRODUCTS

2.01 ELECTRIC CABINET UNIT HEATERS

2.02 MANUFACTURERS:

- A. INDEECO (Industrial Engineering and Equipment Company); _____: www.indeeco.com/#sle.
- B. Marley Engineered Products; _____: www.marleymep.com/#sle.
- C. Stelpro Design Inc; ACF Ceiling Fan Heater: www.stelpro.com/#sle.
- D. Trane Technologies, PLC; ____: www.trane.com/#sle.
- 2.03 PROVIDE PRODUCTS LISTED, CLASSIFIED, AND LABELED BY UNDERWRITERS LABORATORIES INC. (UL), INTERTEK (ETL), OR TESTING FIRM ACCEPTABLE TO AUTHORITY HAVING JURISDICTION AS SUITABLE FOR THE PURPOSE INDICATED.

2.04 HEATING ELEMENTS: PROVIDE OPEN-WIRE, FINNED TUBULAR, OR RESISTANCE WIRE ENCLOSED IN STEEL SHEATH.

2.05 CABINET:

- A. Minimum 18 gauge, 0.0478 inch (1.21 mm) thick steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet, and inlet grilles.
- B. Provide required hardware accessories for ceiling, duct, recessed, semi-recessed, surface, or wall mounting.

2.06 FINISH:

- A. Factory applied, painted finish.
- B. Color: As indicated on drawings.
- 2.07 FAN: FACTORY BALANCED, DIRECT DRIVE, AXIAL TYPE WITH FAN GUARD CONNECTED TO TOTALLY ENCLOSED, THERMALLY PROTECTED MOTOR WITH PERMANENTLY LUBRICATED BEARINGS, AND THERMAL CUTOUT SWITCH WITH AUTOMATIC RESET TO DE-ENERGIZE ELECTRIC HEATING ELEMENTS IN THE EVENT OF OVERHEATING.

2.08 CONTROLS:

- A. Step-down transformer.
- B. Auxiliary relay.
- C. 2-speed fan switch.
- D. Built-in line-voltage thermostat.
- 2.09 FILTER: EASILY REMOVED, 1 INCH (25 MM) THICK GLASS FIBER THROW-AWAY TYPE, LOCATED TO FILTER AIR BEFORE COIL.

2.10 ELECTRICAL CHARACTERISTICS:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Baseboard Radiation:
 - 1. Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated.
 - 2. Center elements under window with elements of equal length centered under each window for multiple windows.
 - 3. Install end caps where units butt against walls.
- E. Finned Tube Radiation:
 - 1. Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated.
 - 2. Center elements under window with elements of equal length centered under each window for multiple windows.
 - 3. Install wall angles and end caps where units butt against walls.
 - 4. Align cabinet joints with window mullions.
 - 5. Install wall angles where units butt against walls and align cabinet joints with window mullions.
- F. Cabinet Unit Heaters:
 - 1. Install as indicated.
 - 2. Coordinate to ensure correct recess size for recessed units.

R23.00331.00

Convection Heating and Cooling Units

Greenwood Lake UFSD - 2023 CIP 238200 - 4

- G. Units with Cooling Coils: Connect drain pan to condensate drain.
- H. Units with Electric Heating Elements:
 - 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
 - 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 260583.

I. Air Coils:

- 1. Cooling Coils:
 - a. Provide three break or six break moisture eliminators of galvanized 24 gauge, 0.0239 inch (0.61 mm) sheet steel, where air velocity exceeds 500 ft/min (2.8 m/sec).
 - b. Cooling Condensate Drain Pan and Drain Connection:
 - 1) Fabricate from galvanized 20 gauge, 0.0359 inch (0.91 mm) sheet steel, extend 3 inches (75 mm) from face of entering air side, 6 inches (150 mm) from the face of the leaving air side, and 4 inches (100 mm) from the face of moisture eliminators.
 - 2) Design slope in accordance with ASHRAE Std 62.1 and install to prevent standing water.
 - 3) Pipe drains individually to location as indicated on drawings with water seal trap.
 - c. Install condensate drain pan under each main cooling coil and intermediate condensate drain pan at each level of stacked cooling coils to collect all condensate from coil assembly, pipe header, pipe return bends, upstream run-off, and downstream carry-over.

3.03 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections
 - 1. Leak test: After installation, charge system and test for leasks. Repair leaks and retest until no leaks exist.
- B. Units will considered defective if they do not pass test and inspections.
- C. Prepare test and inspection reports.

3.04 CLEANING

- A. See Section 017419 Construction Waste Management and Disposal for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- E. Install new filters.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 Closeout Submittals for closeout submittals.
- B. See Section 017900 Demonstration and Training for additional requirements.

3.06 PROTECTION

A. Provide finished cabinet units with protective covers during the balance of construction.

Greenwood Lake Union Free School District R23.00331.00 General Provisions for Electrical Work

Greenwood Lake UFSD - 2023 CIP 260010 - 1

SECTION 260010 GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The work included in this Contract is shown on the drawings and described in these specifications. It consists of furnishing all labor, material, services, supervision and connection of all systems shown and/or specified including the requirements of:
 - DIVISION 00 BIDDING AND CONTRACT REQUIREMENTS 1.
 - **DIVISION 1 GENERAL REQUIREMENT** 2.
 - 3. DIVISION 26.27.28 - GENERAL REQUIREMENT
- B. Contractor is responsible to review and understand all drawings and all work of all trades to ensure a complete and thorough project.
- Provide all labor, tools, materials, equipment, coordination, and plans necessary for installation C. and proper operation of the electrical systems.
- D. Contract drawings and specifications are complementary and must be so used to ascertain all requirements of the work.

1.02 DEFINITIONS

- A. Provide, furnish, install, and furnish and install shall have the same meaning. That is, the Contractor shall purchase, transport to the site and install all required components of the work unless specifically stated otherwise in the contract documents.
- B. Wiring pertains to raceway, fittings, conductors, terminations, hangers, supports, etc. as required to form a complete system.

1.03 DRAWINGS AND SPECIFICATIONS

- A. The plans are diagrammatic and indicate only the sizes and general arrangement of conduit, devices, and equipment; exact locations of all elements shall be determined as work progresses, in cooperation with the work of other trades. It is not intended to show every item of work or minor piece of equipment, but every item shall be furnished and installed without additional remuneration as necessary to complete the system in accordance with the best practice of the trade.
- As previously stated, the exact locations of electrical devices and equipment are diagrammatic. B. The owner may request for any devices or equipment to be installed at different locations than what is indicated on the drawings in a specific area or room. It is the responsibility of the Electrical Contractor to coordinate the locations of devices in all areas prior to installation.

1.04 PRODUCT EQUIVALENTS

- A. Where, in these specifications or on drawings, certain kinds, types, brands, or manufacturers of materials are named, they shall be regarded as required standard of quality. Where two or more are named these are presumed to be equal, and Contractor may select one of those items.
- Β. If Contractor desires to use any kind, type, brand, or manufacturer of material other than those named in specification, he may submit the request for approval to the Architect well in advance of the bid date.
- C. Requests for approval of proposed equivalents will be received by Architect only from the Contractor.

- D. If the Architect approves a proposed equivalent prior to receipt of Bids, such approval will be set forth in an Addendum.
- E. After the bid opening the apparent low bidder or bidders will be notified by the Architect or Owner and shall submit to the Architect in writing, within ten (10) calendar days what equivalent kind, type, brand, or manufacture is included in bid in lieu of specified items. No equivalents will be considered after this submission.
- Contractor shall have burden of proving, at Contractor's own cost and expense, to satisfaction F. of Owner/Architect, that proposed product is similar and equal to named product. In making such determination Owner/Architect will be sole judge of objective and appearance criteria that proposed product must meet in order for it to be approved.
 - 1. Supporting data on equivalency is responsibility of bidder. For each equivalent to base specification, included in products list, submit information describing in specific detail:
 - Wherein it differs from quality and performance required by base specification. a.
 - Changes required in other elements of work because of equivalent. b.
 - C. Effect on construction schedule.
 - d. Any required license fees or royalties.
 - e. Availability of maintenance service, and source of replacement materials.
 - Such other information as may be required by Owner. f.
- G. Owner, through Architect, shall be judge of acceptability of proposed equivalents. Risk of whether bid equivalents will be accepted is borne by Contractor.
- Submission of an equivalent product and/or material constitutes a representation that H. Contractor:
 - Has investigated proposed product and determined it is equal to or superior in all respects 1. to that specified.
 - 2. Will provide same warranties or bonds for equivalent as for product specified.
 - Will coordinate installation of an accepted equivalent into work and make such other 3. changes as may be required to make work complete in all respects.
 - 4. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
 - 5. Will provide, at own cost and expense, any different quantity and/or arrangement of ductwork, piping, wiring, conduit or any part of work from that specified, detailed or indicated in Contract Documents if required for proper installation of an approved equivalent.
 - 6. Will provide, at own cost and expense, all such revision and redesign and all new drawings and details required by Architect for approval if proposed equivalent product requires a revision or redesign of any part of work covered by this contract.
- Contractor must sign the "Equivalent Certification" following this specification section and Ι. deliver it to the Architect along with a complete list of proposed equivalents within ten (10) calendar days after notification from the Architect or Owner. This is mandatory and must be done prior to award of contracts.

1.05 APPLICABLE STANDARDS

- A. All equipment shall bear the UL label.
- The latest edition of the following minimum standards shall apply wherever applicable: Β.
 - American Standards Association 1.
 - 2. American Society for Testing Materials
 - 3. Electrical Testing Laboratories, Inc.
 - Institute of Electrical and Electronic Engineers 4.

R23.00331.00

General Provisions for Electrical Work

Greenwood Lake UFSD - 2023 CIP 260010 - 3

- 5. Insulated Power Cable for Engineers Association
- 6. Occupational Safety and Health Act
- 7. National Electric Code
- 8. National Electrical Manufacturers Association
- 9. National Electrical Safety Code
- 10. National Fire Protection Association
- 11. Underwriters Laboratories, Inc.
- 12. Local and state codes.
- C. In the event there are conflicts between specifications and standards, standards shall govern unless specifications are in excess of standards.

1.06 PERMITS AND INSPECTIONS

- A. Permits: The Contractor shall apply for and pay the cost for any local permits necessary for the work of this contract.
- B. Inspections: The Contractor shall be responsible for obtaining a 3rd party electrical inspection of and the certificate by the approved inspection agency for the entire electrical system.
- C. The undertaking of periodic inspections by the Owner or Engineer shall not be construed as supervision of actual construction. The Owner or Engineer is not responsible for providing a safe place of work for the Contractor, Contractor's employees, suppliers or subcontractors for access, visits, use, work, travel or occupancy by any person.

1.07 CODES AND REGULATIONS

- A. Comply with all applicable rules and regulations of the municipal laws and ordinances and latest revisions thereof. All work shall be done in full conformity with the requirements of all authorities having jurisdiction. Modifications required by the above authorities will be made without additional charges to the Owner. Where alterations to and/or deviations from the Contract Documents are required by the authorities, report the requirements to the Engineer and secure approval before work is started.
- B. Furnish and file with the proper authorities, all drawings required by them in connection with the work. Obtain all permits, licenses, and inspections and pay all legal and proper fees and charges in this connection.
- C. Should any work shown or specified be of lighter or smaller material than Code requires, same shall be executed in strict accordance with the regulations.
- D. Heavier or larger size material than Code requires shall be furnished and installed, if required by the Plans and Specifications.
- E. This Contractor shall have the electrical work inspected from time to time by authorized inspectors and shall pay all expense incurred by same. At the completion of the work, the Contractor shall furnish a Certificate of Approval, in triplicate, indicating full approval of the work furnished and installed in this Contract from the local authority having jurisdiction.
- F. Equipment and components parts thereof shall bear manufacturer's name-plate, giving manufacturer's name, size, type and model number or serial number, electrical characteristic to facilitate maintenance and replacements. Name plates of distributors or contractors are not acceptable.

- G. Engineer will have privilege of stopping any work or use of any material that in his opinion is not being properly installed and each Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed by the Engineer, at no additional cost to Owner.
- H. If equipment or materials are installed before proper approvals have been obtained, each Contractor shall be liable for their removal and replacement including work of other trades affected by such work, at no additional cost to Owner, if such items do not meet intent of the Drawings and Specifications.

1.08 RECORD DRAWINGS

- A. The Electrical Contractor shall keep an accurate location record of all underground and concealed piping, and of all changes from the original design. He is required to furnish this information to the Engineer prior to his application for final payment.
 - 1. Submit prior to final acceptance inspection, one complete marked-up set of reproducible engineering design drawings.
 - a. Fully illustrate all revisions made by all crafts in course of work.
 - b. Include all field changes, adjustments, variances, substitutions and deletions, including all Change Orders.
 - c. Exact location of raceways, equipment and devices.
 - d. Exact size and location of underground and under floor raceways, grounding conductors and duct banks.
 - e. These drawings shall be for record purposes for Owner's use and are not considered shop drawings.
- B. At completion of the project, all changes and deviations from the Contract Documents shall be recorded by the Contractor.
- C. Four (4) corrected sets of all operating and maintenance instructions and complete parts lists bound in hard covers shall be furnished to the Owner.

1.09 SLEEVES

- A. Sleeves: furnished, set in Electrical Work; built-in under General Construction Work.
- B. Sleeves shall be as follows:
 - 1. Sleeves in floors and partitions shall be galvanized steel with lock seam joints or a manufactured conduit floor seal.
 - 2. Sleeves of extra heavy cast iron pipe or galvanized steel pipe shall be used in outside walls, foundations, and footing or manufactured compression-type wall seal (waterproof).
 - 3. Conduit sleeves shall be two (2) sizes larger than the conduit passing through it.
 - 4. Terminate sleeves flush with walls, partitions, and ceilings. Sleeves in floor shall terminate 1/4" above floors.
 - 5. Fill space between sleeve and conduit in foundation walls with oakum and caulk with lead on both sides of wall. When using pipe sleeves, fill space between sleeve and pipe with fiberglass blanket insulation when sleeve does not occur in a foundation wall.
 - 6. An approved fire stop seal shall be used when conduits penetrate fire stopping walls and floors (between fire zone).
- C. Set sleeves, obtain review of their locations in ample time to permit pouring of concrete or progressing of other construction work as scheduled.

R23.00331.00

1.10 CLEANING CONDUIT, EQUIPMENT

A. Conduit, equipment: thoroughly cleaned of dirt, cuttings, other foreign substances. Should any conduit, other part of systems be stopped by any foreign matter, disconnect, clean wherever necessary for purpose of locating, removing obstructions. Repair work damaged in course of removing obstructions.

1.11 VIBRATION ISOLATION

- A. Vibration isolators shall prevent, as far as practicable, transmission of vibration, noise or hum to any part of building.
- B. Design isolators to suit vibration frequency to be absorbed; provide isolator units of area, distribution to obtain proper resiliency under machinery load, impact.
- C. Wiring and other electrical connections to equipment mounted on vibration isolators; made flexible with minimum 180 degree loop of "greenfield" in order to avoid restraining equipment and short circuiting vibration isolator.

1.12 BALANCED LOAD

- A. It is intended that design and features of the work as indicated will provide balanced load on the feeders and main service. Contractor shall provide material and installation to provide this balance load insofar as possible.
- B. Contractor shall take current and voltage measurements at all panels of at least 1/2 hour. Reconnections of loads shall be made when deemed necessary by the Engineers.

1.13 JOB CONDITIONS

- A. Examine site related work and surfaces before starting work of any Section. Failure to do so shall in no way relieve the Contractor of the responsibility to properly install the new work.
 - 1. Report to the Engineer, in writing, conditions, which will prevent proper provision of this work ten (10) days prior to bid date, in time for an addendum to be issued .
 - 2. Beginning work of any Section without reporting unsuitable conditions to the Engineer constitutes acceptance of conditions by the Contractor.
 - 3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.
 - 4. The Contractor is responsible for performing routine maintenance and cleaning of any existing equipment where he is making connections to new work and to the building where his work adds debris.
- B. Connections to existing work:
 - 1. Install new work and connect to existing work with minimum interference to existing facilities.
 - 2. Provide temporary shutdowns of existing services only with written consent of Owner at no additional charges and at time not to interfere with normal operation of existing facilities.
 - 3. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
 - 4. Do not interrupt alarm and emergency systems.
 - 5. Connect new work to existing work in neat and acceptable manner.
 - 6. Restore existing disturbed work to original condition including maintenance of wiring and continuity as required. Replace damaged or rusted conduit to which new equipment is being installed and connected.
- C. Removal and relocation of existing work.
 - 1. Disconnect, remove or relocate electrical material, equipment and other work noted and required by removal or changes in existing construction.

R23.00331.00

General Provisions for Electrical Work

Greenwood Lake UFSD - 2023 CIP 260010 - 6

- 2. Provide new material and equipment required for relocated equipment.
- 3. Disconnect load and line end of conductors feeding existing equipment.
- 4. Remove conductors from existing raceways to be rewired.
- 5. Remove conductors and cap outlets on raceways to be abandoned.
- 6. Cut and cap abandoned floor raceways flush with concrete floor or behind walls and ceilings.
- 7. Dispose of removed raceways and wire.
- 8. Dispose of removed electrical equipment as directed by Owner. The Owner shall provide a list of equipment of the Contractor of equipment to be delivered to the Owner.

1.14 SPECIAL TOOLS AND LOOSE ITEMS

- A. Furnish to Owner at completion of work:
 - 1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.
 - 2. "Special Tools": Those not normally found in possession of mechanics or maintenance personnel.
 - 3. Keys
 - 4. Redundant components and spare parts.
- B. Deliver items to Owner and obtain receipt prior to approval of final payment.

1.15 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by representative of the Engineer.
- B. Advise Architect and Engineer that work is ready for review at following times:
 - 1. Prior to backfilling buried work.
 - 2. Prior to concealment of work in walls and above ceilings.
 - 3. When all requirements of contract have been completed.
- C. Neither backfill nor conceal work without Engineer's consent.

1.16 SHOP DRAWING SUBMITTALS

- A. Submit required shop drawings, samples and product information in accordance with Division 1, requirements and as required in the various sections of these specifications.
- B. Submittals shall show evidence of checking by the Contractor for accuracy. Product information (catalog sheets) shall indicate complete catalog number, color, accessories, etc., as well as, name of manufacturer and local distributor or manufacturer's representative.
- C. Submit for review detailed coordination drawings 3/8" or larger scale plans for all major electrical equipment and any areas of conflicts by drafting location of equipment, lighting fixtures, cable trays and conduits larger than 1-1/2" trade size. Contractor shall refer to Division 1 for preparing coordination drawings.
- D. Incomplete submittals will be rejected.
- E. Additionally, the Contractor will submit data on the following:
 - 1. All electrical equipment including all panelboards and switching devices (disconnects, switches, occupancy sensors, etc.).
 - 2. Fire stop seals used for wall penetrations.
 - 3. Any proposed variation in specified wiring plans and circuitry.
 - 4. All special items and panels, made or constructed specifically for this project, including wiring diagrams, component layout and component data or materials list.

- 5. All settings of installed equipment, such as overcurrent protection, overload settings, temperature settings, time settings, etc. This includes equipment provided by other contractors or subcontractors and connected and tested by this Contractor.
- F. All submittals of NON SPECIFIED equipment and components will be reviewed. It is the submitting Contractor's responsibility to prove compliance and not the Architect/Engineer to prove non-compliance. The submitting Contractor will be charged the prevailing wage of the reviewing Engineer for all submittals requiring over one (1) hour to review that were not originally specified.
- G. It is the Contractor's responsibility to provide submittals in an organized and timely manner so as not to delay the project schedule and hamper the work of other trades.

1.17 OPERATING INSTRUCTIONS

A. It shall be the Contractor's responsibility to insure that the Owner's representative is given adequate instruction on the operation of all equipment prior to final payment.

1.18 TEMPORARY POWER

A. The Contractor shall provide all temporary power to all trades throughout all phases of construction throughout the duration of this project. This will include but not be limited to temporary lighting, power outlets, temporary elevator operation, controls for temporary heating, and job trailers. Contractor shall be responsible for providing temporary power via adjacent building(s) and/or a temporary diesel fired generator and associated fuel costs. Contractor shall coordinate temporary power source with project manager prior to demolition. Contractor is responsible for all costs associated with temporary power.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials and equipment shall be new and as specified or of equal or better quality.
- B. Basic hardware and miscellaneous items shall meet existing trade standards of quality and shall carry UL or FM listings where applicable.
- C. All equipment supplied shall be the standard equipment of the manufacturer.
- D. Multiple items such as panelboards, wiring devices, switches, breakers, raceways, etc., shall be from the same manufacturer.
- E. Drawings and specifications are based on specific manufacturer's equipment. Therefore, the Contractor shall assume all responsibility, cost and coordination involved in making any necessary revisions to apply another manufacturer's equipment, even though it may be approved as an "equal" item by the Engineer.

PART 3 EXECUTION

3.01 COORDINATION OF WORK

- A. All work shall be executed in accordance with recognized standards of workmanship. All work shall be installed in a neat and orderly manner.
- B. The Contractor shall exchange information with other Contractors and the Owner in order to insure orderly progress of the work.
- C. The Contractor must contact the Owner's representative and schedule all work ten (10) days prior to start.
- D. The Contractor shall check for possible interference before installing any items. If any work is installed, and later develops interference with other features of the design, the Contractor will be responsible to make such changes to eliminate the interference.

3.02 CEILING REMOVAL

- A. Existing ceilings which must be removed for the installation of new work or demolition of existing conditions shall be done by the Contractor. No ceiling shall be removed without prior approval of the Owner. Ceilings which must be removed shall be restored to their original condition as soon as practical and prior to final payment.
- B. The removed tile of lay-in type ceilings shall be stored either in the ceiling space or at a designated space in the building. No tiles shall be stored in the occupied space.
- C. The Contractor shall take all necessary precautions to prevent damage to the existing ceilings. All damaged ceilings shall be replaced with new ceiling construction to match the existing and to the Owner's satisfaction.

Selective Demolition for Electrical

Greenwood Lake UFSD - 2023 CIP 260505 - 1

SECTION 260505 SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

R23.00331.00

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 RELATED REQUIREMENTS

A. Section 017000 - Execution and Closeout Requirements: Additional requirements for alterations work.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Architect before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner before partially or completely disabling system.
 - 2. Notify local fire service.
 - 3. Make notifications at least 48 hours in advance.
 - 4. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner at least 48 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

Greenwood Lake Union Free School District R23.00331.00 Selective Demolitie

- Selective Demolition for Electrical
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A. See Section 017419 Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

Greenwood Lake UFSD - 2023 CIP ors and

R23.00331.00

Low-Voltage Electrical Power Conductors and Cables

260519 - 1

SECTION 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Wire pulling lubricant.
- G. Cable ties.
- H. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 078400 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.

1.03 REFERENCE STANDARDS

- A. ASTM B3 Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- F. ASTM D4388 Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- G. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- H. NECA 120 Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
- I. NEMA WC 70 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- J. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- K. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Low-Voltage Electrical Power Conductors and

Cables

- M. UL 83 Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 267 Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- O. UL 486A-486B Wire Connectors; Current Edition, Including All Revisions.
- P. UL 486C Splicing Wire Connectors; Current Edition, Including All Revisions.
- Q. UL 486D Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- R. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- UL 1569 Metal-Clad Cables; Current Edition, Including All Revisions. S

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors C. substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- D. Field Quality Control Test Reports.
- E. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 FIELD CONDITIONS

Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower Α than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Low-Voltage Electrical Power Conductors and Cables

260519 - 3

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

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

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- Provide products that comply with requirements of NFPA 70.
- Provide products listed, classified, and labeled as suitable for the purpose intended. B.
- 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.
- Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83. E.
- 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.
 - Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper 2. conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- H. Minimum Conductor Size:
 - Branch Circuits: 12 AWG. 1
 - Exceptions: a.
 - 20 A, 120 V circuits longer than 100 feet: 10 AWG, for voltage drop. 1)
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
- Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable Ι. minimum size requirements specified.
- Conductor Color Codina: J.
 - Color code conductors as indicated unless otherwise required by the authority having 1. jurisdiction. Maintain consistent color coding throughout project.
 - Color Coding Method: Integrally colored insulation. 2.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Low-Voltage Electrical Power Conductors and Cables

260519 - 4

- a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
- 3. Color Code:
 - 208Y/120 V, 3 Phase, 4 Wire System: a.
 - Phase A: Black. 1)
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - Neutral/Grounded: White. 4)
 - Equipment Ground, All Systems: Green. b.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - Copper Building Wire: 1.
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servicewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. f.
- В. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - Feeders and Branch Circuits: 1.
 - a. Size 10 AWG and Smaller: Solid.
 - Size 8 AWG and Larger: Stranded. b.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.04 METAL-CLAD CABLE

- Α. Manufacturers:
 - AFC Cable Systems Inc: www.afcweb.com/#sle. 1.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - Service Wire Co: www.servicewire.com/#sle. 3.
 - 4 Southwire Company: www.southwire.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- 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:
 - Size 10 AWG and Smaller: Solid. 1.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor where indicated or required.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Armor: Steel, interlocked tape.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Low-Voltage Electrical Power Conductors and Cables

260519 - 5

I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.05 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. Connectors for Grounding and Bonding: Comply with Section 260526.
- C. 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.
- D. 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.
 - 6. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) 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.
 - d. Substitutions: See Section 016000 Product Requirements.
- G. Push-in Wire Connectors: Rated 600 V, 221 degrees F (105 degrees C).
 - 1. Manufacturers:
 - a. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - b. NSI Industries LLC: www.nsiindustries.com/#sle.
 - c. Wago Corporation: www.wago.us/#sle.
- H. Mechanical Connectors: Provide bolted type.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Ilsco: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 Product Requirements.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Low-Voltage Electrical Power Conductors and Cables

260519 - 6

Compression Connectors: Provide circumferential type or hex type crimp configuration. Ι.

- Manufacturers: 1.
 - Burndy LLC: www.burndy.com/#sle. a.
 - Ilsco: www.ilsco.com/#sle. b.
 - C. Thomas & Betts Corporation: www.tnb.com/#sle.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - Manufacturers: 1.
 - a. Burndy LLC: www.burndy.com/#sle.
 - Ilsco: www.ilsco.com/#sle. b.
 - C. Thomas & Betts Corporation: www.tnb.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. d.

2.06 ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - 3M: www.3m.com/#sle. а
 - Plymouth Rubber Europa: www.plymouthrubber.com/#sle. b.
 - Substitutions: See Section 016000 Product Requirements. C.
 - Vinvl Color Coding Electrical Tape: Integrally colored to match color code indicated: listed 2. as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil (0.76 mm); suitable for continuous temperature environment up to 194 degrees F (90 degrees C) and short-term 266 degrees F (130 degrees C) overload service.
 - Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 5. mil (3.2 mm); suitable for continuous temperature environment up to 176 degrees F (80 degrees C).
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, allweather vinvl backing: minimum thickness of 90 mil (2.3 mm).
- Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; Β. suitable for direct burial applications; listed as complying with UL 486D.
- C. Wire Pulling Lubricant:
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - American Polywater Corporation: www.polywater.com/#sle. b.
 - Ideal Industries, Inc: www.idealindustries.com/#sle. C.
 - Substitutions: See Section 016000 Product Requirements. d.
 - 2. Listed and labeled as complying with UL 267.
 - Suitable for use with conductors/cables and associated insulation/jackets to be installed. 3.
 - 4. Suitable for use at installation temperature.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Low-Voltage Electrical Power Conductors and Cables

260519 - 7

- 5. Products:
 - a. American Polywater Corporation; Polywater J Cable Pulling Lubricant: www.polywater.com/#sle.
 - American Polywater Corporation: Polywater LZ Cable Pulling Lubricant: b. www.polywater.com/#sle.
- D. Cable Ties: Material and tensile strength rating suitable for application.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. b.
- Sealing Systems for Roof Penetrations: Premanufactured components and accessories as E. required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - Products: 1.
 - Menzies Metal Products; Electrical Roof Stack and Cap: www.menziesа metal.com/#sle.
 - Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle. b.
 - Substitutions: See Section 016000 Product Requirements. С
- F. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - Products: 1.
 - HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro a. Series/HvdroFlame Custom Built: www.holdrite.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. b.

PART 3 EXECUTION

3.01 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 field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Circuiting Requirements:
 - Unless dimensioned, circuit routing indicated is diagrammatic. 1.
 - 2. When circuit destination is indicated without specific routing, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location 4. indicated.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Low-Voltage Electrical Power Conductors and 260 Cables

260519 - 8

- 5. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
- 6. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- 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.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- 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.
- I. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- L. 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.

Greenwood Lake UFSD - 2023 CIP

R23.00331.00

Low-Voltage Electrical Power Conductors and Cables

260519 - 9

- 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
- 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. 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.
 - 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.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- P. Identify conductors and cables in accordance with Section 260553.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- 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.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. 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.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

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strictGreenwood Lake UFSD - 2023 CIPad Bonding for Electrical Systems260526 - 1

R23.00331.00 Grounding and Bonding for Electrical Systems

SECTION 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.

1.02 RELATED REQUIREMENTS

- A. Section 260519 Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 260553 Identification for Electrical Systems: Identification products and requirements.
- C. Section 265600 Exterior Lighting: Additional grounding and bonding requirements for polemounted luminaires.

1.03 REFERENCE STANDARDS

- A. IEEE 81 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- C. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- D. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 467 Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. 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.

R23.00331.00

- _
 - D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
 - F. 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. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 - 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.

2.02 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 260526:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Grounding and Bonding for Electrical Systems

- 1) Use bare copper conductors where installed underground in direct contact with earth.
- 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
 - Description: Connectors appropriate for the application and suitable for the conductors 1. and items to be connected; listed and labeled as complying with UL 467.
 - Unless otherwise indicated, use exothermic welded connections for underground, 2. concealed and other inaccessible connections.
 - Unless otherwise indicated, use mechanical connectors, compression connectors, or 3. exothermic welded connections for accessible connections.
 - Manufacturers Mechanical and Compression Connectors: 4.
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - nVent ERICO: www.nvent.com/#sle. C.
 - Thomas & Betts Corporation: www.tnb.com/#sle. d.
 - 5. Manufacturers - Exothermic Welded Connections:
 - Burndy LLC: www.burndy.com/#sle. a.
 - b. nVent ERICO; Cadweld: www.nvent.com/#sle.
 - thermOweld, subsidiary of Continental Industries; division of Burndy LLC: С www.thermoweld.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Make grounding and bonding connections using specified connectors.
 - Remove appropriate amount of conductor insulation for making connections without 1. cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - Remove nonconductive paint, enamel, or similar coating at threads, contact points, and 2 contact surfaces.
 - Exothermic Welds: Make connections using molds and weld material suitable for the 3. items to be connected in accordance with manufacturer's recommendations.
 - Mechanical Connectors: Secure connections according to manufacturer's recommended 4. torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- D. Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - BSD Quality Requirements, for additional requirements.

- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
ee School DistrictGreenwood Lake UFSD - 2023 CIPHangers and Supports for Electrical Systems260529 - 1

R23.00331.00 Hange

SECTION 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260533.13 Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 260533.16 Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 262513 Low-Voltage Busways: Additional support and attachment requirements for busway.
- E. Section 265100 Interior Lighting: Additional support and attachment requirements for interior luminaires.
- F. Section 265600 Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- 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; 2015.
- F. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect of 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 cured; see Section 033000.

DistrictGreenwood Lake UFSD - 2023 CIPand Supports for Electrical Systems260529 - 2

R23.00331.00 Hangers and Supports for Electrical Systems

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - Comply with the following. Where requirements differ, comply with most stringent.
 a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent; Caddy: www.nvent.com/#sle.
 - f. Substitutions: See Section 016000 Product Requirements.
 - 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Hangers and Supports for Electrical Systems

260529 - 3

- 3. Conduit Clamps: Bolted type unless otherwise indicated.
- 4 Products:
 - a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - Gripple, Inc; Fast Trak: www.gripple.com/#sle. b.
 - Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle. C.
 - d. Gripple, Inc; Low Profile Bracket Kits: www.gripple.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. e.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - Manufacturers: 1.
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - C. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent: Caddy: www.nvent.com/#sle.
 - f. Substitutions: See Section 016000 - Product Requirements.
- D. Metal Channel/Strut Framing Systems:
 - Manufacturers: 1.
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - C. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
 - d. Eaton Corporation: www.eaton.com/#sle.
 - e. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. f.
 - Source Limitations: Furnish channel/strut and associated fittings, accessories, and g. hardware produced by single manufacturer.
 - 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 3. Comply with MFMA-4.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 - Minimum Size, Unless Otherwise Indicated or Required: 1
 - Equipment Supports: 1/2-inch (13 mm) diameter. a.
 - Busway Supports: 1/2-inch (13 mm) diameter. b.
 - Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter. C.
 - d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.
 - Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter. e.
 - Outlet Boxes: 1/4-inch (6 mm) diameter. f.
 - Luminaires: 1/4-inch (6 mm) diameter. q.
- F. Anchors and Fasteners:
 - Manufacturers Mechanical Anchors: 1
 - Dewalt: anchors.dewalt.com/#sle. a.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. e.
 - Manufacturers Powder-Actuated Fastening Systems: 2.
 - Dewalt: anchors.dewalt.com/#sle. a.
 - b. Hilti. Inc: www.hilti.com/#sle.

R23.00331.00

Greenwood Lake UFSD - 2023 CIP Hangers and Supports for Electrical Systems

260529 - 4

- c. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
- d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- e. Substitutions: See Section 016000 - Product Requirements.
- Unless otherwise indicated and where not otherwise restricted, use anchor and fastener 3. types indicated for specified applications.
- Concrete: Use preset concrete inserts, expansion anchors, or screw anchors. 4.
- Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors. 5.
- Hollow Masonry: Use toggle bolts. 6.
- 7. Hollow Stud Walls: Use toggle bolts.
- 8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
- Sheet Metal: Use sheet metal screws. 9.
- 10. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - C. Channel Material: Use galvanized steel.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports 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 Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, 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:
 - Use metal, fabricated supports or supports assembled from metal channel/strut to support 1. 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.
 - Use metal channel/strut to support surface-mounted equipment in wet or damp locations 3. to provide space between equipment and mounting surface.
 - Securely fasten floor-mounted equipment. Do not install equipment such that it relies on 4. its own weight for support.
- H. Conduit Support and Attachment: See Section 260533.13 for additional requirements.
- Busway Support and Attachment: See Section 262513 for additional requirements. Ι.
- Interior Luminaire Support and Attachment: See Section 265100 for additional requirements. J.
- K. Exterior Luminaire Support and Attachment: See Section 265600 for additional requirements.

R23.00331.00

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ee School DistrictGreenwood Lake UFSD - 2023 CIPHangers and Supports for Electrical Systems260529 - 5

- Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- M. Secure fasteners in accordance with manufacturer's recommended torque settings.
- N. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 BSD 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 260529

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Conduit for Electrical Systems

Greenwood Lake UFSD - 2023 CIP 260533.13 - 1

SECTION 260533.13 CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

R23.00331.00

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Stainless steel electrical metallic tubing (EMT).

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 260519 Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.
- C. Section 260526 Grounding and Bonding for Electrical Systems.
 1. Includes additional requirements for fittings for grounding and bonding.
- D. Section 260529 Hangers and Supports for Electrical Systems.
- E. Section 260533.16 Boxes for Electrical Systems.
- F. Section 260553 Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 101 Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- E. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- 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 6A Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- J. UL 360 Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- K. UL 514B Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- L. UL 746C Polymeric Materials Use in Electrical Equipment Evaluations; Current Edition, Including All Revisions.
- M. UL 797 Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- N. UL 797A Electrical Metallic Tubing Aluminum and Stainless Steel; Current Edition, Including All Revisions.

O. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

R23.00331.00

- 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
- 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
- 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
- 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
- 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Concealed Within Hollow Stud Walls: Use galvanized steel electrical metallic tubing (EMT).
- D. Concealed Above Accessible Ceilings: Use galvanized steel electrical metallic tubing (EMT).
- E. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC).
- F. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel electrical metallic tubing (EMT).
- G. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- H. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
 - 1. Locations subject to severe physical damage include, but are not limited to:

R23.00331.00

Conduit for Electrical Systems

- a. High traffic industrial and warehouse areas where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
- b. Where exposed below 20 feet (6.1 m) in industrial manufacturing areas.
- I. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- J. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
- C. Fittings for Grounding and Bonding: See Section 260526 for additional requirements.
- D. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- E. Provide products listed, classified, and labeled as suitable for purpose intended.
- F. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
 - 3. Flexible Connections to Luminaires: 3/8-inch (12 mm) trade size.
- G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - e. Substitutions: See Section 016000 Product Requirements.
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

Greenwood Lake Union Free School District R23.00331.00 Conduit for F

Conduit for Electrical Systems

Greenwood Lake UFSD - 2023 CIP 260533.13 - 4

- 1. Calbrite, a division of Atkore International: www.calbrite.com/#sle.
- 2. Gibson Stainless & Specialty Inc: www.gibsonstainless.com/#sle.
- 3. Patriot Industries, a division of Patriot Aluminum Products LLC: www.patriotsas.com/#sle.
- 4. Substitutions: See Section 016000 Product Requirements.
- B. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.
 - 1. Material: Type 304 or 316 stainless steel.
- C. Fittings:
 - 1. Manufacturers:
 - a. Calbrite, a division of Atkore International: www.calbrite.com/#sle.
 - b. Eaton: www.eaton.com/#sle.
 - c. Gibson Stainless & Specialty Inc: www.gibsonstainless.com/#sle.
 - d. Patriot Industries, a division of Patriot Aluminum Products LLC: www.patriotsas.com/#sle.
 - e. Substitutions: See Section 016000 Product Requirements.
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
 - 3. Material: Use stainless steel with corrosion resistance equivalent to conduit.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Electri-Flex Company: www.electriflex.com/#sle.
 - 3. International Metal Hose: www.metalhose.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- 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.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Substitutions: See Section 016000 Product Requirements.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Electri-Flex Company: www.electriflex.com/#sle.
 - 3. International Metal Hose: www.metalhose.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:

Conduit for Electrical Systems

Greenwood Lake UFSD - 2023 CIP 260533.13 - 5

1. Manufacturers:

R23.00331.00

- a. ABB; T&B: www.electrification.us.abb.com/#sle.
- b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
- c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
- d. Substitutions: See Section 016000 Product Requirements.
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
- 3. Material: Use steel or malleable iron.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

- 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - e. _____
 - f. Substitutions: See Section 016000 Product Requirements.
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
- 3. Material: Use steel or malleable iron.
- 4. Connectors and Couplings: Use compression/gland type.

a. Do not use indenter type connectors and couplings.

2.08 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Calbrite, a division of Atkore International: www.calbrite.com/#sle.
 - 2. Substitutions: See Section 016000 Product Requirements.
- B. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.
- C. Fittings:
 - 1. Manufacturers:
 - a. Calbrite, a division of Atkore International: www.calbrite.com/#sle.
 - b. Substitutions: See Section 016000 Product Requirements.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use stainless steel with corrosion resistance equivalent to conduit.
 - 4. Connectors and Couplings: Use compression/gland type.

2.09 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch (0.51 mm).

- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- E. Adhesive for HDPE and RTRC Conduit:
 - 1. Specifically designed for bonding dissimilar materials in lieu of transition fittings, including but not limited to polyethylene, fiberglass, PVC, aluminum, and steel; UL 746C recognized.
 - 2. Approved by adhesive manufacturer for use with materials to be joined.
- F. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf (5.6 kN).
- G. Sealing Systems for Concrete Penetrations:
 - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
 - 3. Products:
 - a. American Polywater Corporation; PZVR Cement-Coated Concrete Wall Sleeves: www.polywater-haufftechnik.com/#sle.
 - b. American Polywater Corporation; PHSD Mechanical Seals: www.polywater-haufftechnik.com/#sle.
 - c. American Polywater Corporation; PHSI 150 Varia Double Wall Inserts: www.polywater-haufftechnik.com/#sle.
 - d. American Polywater Corporation; PGKD Modular Seals: www.polywaterhaufftechnik.com/#sle.
 - e. Substitutions: See Section 016000 Product Requirements.
- H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
 - 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menziesmetal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Substitutions: See Section 016000 Product Requirements.
- I. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
 - 1. Products:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - b. Substitutions: See Section 016000 Product Requirements.
- J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.

b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. 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 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. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 6. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 - 7. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
 - 8. Route conduits above water and drain piping where possible.
 - 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 10. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
- E. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 - 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 - 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 - 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 - 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 - 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 - 9. Use of spring steel conduit clips for support of conduits is not permitted.

R23.00331.00

- a. Support of electrical metallic tubing (EMT) up to 1-inch (27 mm) trade size concealed above accessible ceilings and within hollow stud walls.
- 10. Use of wire for support of conduits is not permitted.
- 11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- F. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.
 - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 - 6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 - 7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 - 8. Secure joints and connections to provide mechanical strength and electrical continuity.
- G. 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. Provide suitable sealing system where conduits penetrate exterior wall below grade.
 - 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.
 - 8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.
- H. 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.
 - 2. Where conduits are subject to earth movement by settlement or frost.
- I. Conduit Sealing:
 - 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.

R23.00331.00

Conduit for Electrical Systems

Greenwood Lake UFSD - 2023 CIP 260533.13 - 9

- d. Where conduits may transport moisture to contact live parts.
- 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- J. Provide grounding and bonding; see Section 260526.
- K. Identify conduits; see Section 260553.

3.03 FIELD QUALITY CONTROL

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

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 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.

END OF SECTION 260533.13

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Greenwood Lake Union Free School District R23.00331.00 Boxes for Ele

Boxes for Electrical Systems

SECTION 260533.16 BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Boxes for hazardous (classified) locations.

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 083100 Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 260529 Hangers and Supports for Electrical Systems.
- D. 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.
- E. Section 260553 Identification for Electrical Systems: Identification products and requirements.
- F. Section 262726 Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.
- G. Section 271000 Structured Cabling: Additional requirements for communications systems outlet boxes.

1.03 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- 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 508A Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A Metallic Outlet Boxes; Current Edition, Including All Revisions.

K. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.04 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 flushmounted boxes where indicated.
 - 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- D. Maintenance Materials: Furnish the following for Owner'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.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 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.

R23.00331.00

Boxes for Electrical Systems

- 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), 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 suitable concrete type boxes where flush-mounted in concrete.
 - 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 - 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 - 7. Use shallow boxes where required by the type of wall construction.
 - 8. Do not use "through-wall" boxes designed for access from both sides of wall.
 - 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 - 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 - 11. 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.
 - 12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 - 13. Wall Plates: Comply with Section 262726.
 - 14. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 016000 Product Requirements.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet (0.56 sq m) and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 - 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.b. Back Panels: Painted steel, removable.
 - 5. Manufacturers:

R23.00331.00

Boxes for Electrical Systems

Greenwood Lake UFSD - 2023 CIP 260533.16 - 4

- a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
- c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
- d. Substitutions: See Section 016000 Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) 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. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. 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 as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
 - b. Communications Systems Outlets: Comply with Section 271000.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
 - 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.
 - 9. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:

Greenwood Lake Union Free School District R23.00331.00 Boxes for Electrical Systems

- 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.
- 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- J. Install boxes plumb and level.
- K. 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 (6 mm) 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 (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- 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. Identify boxes in accordance with Section 260553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260533.16

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Identification for Electrical Systems

Greenwood Lake UFSD - 2023 CIP 260553 - 1

SECTION 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

R23.00331.00

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 099113 Exterior Painting.
- B. Section 099123 Interior Painting.
- C. Section 260519 Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 262726 Wiring Devices Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- E. Section 271000 Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

- A. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 969 Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 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.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

Greenwood Lake UFSD - 2023 CIP 260553 - 2

R23.00331.00

Identification for Electrical Systems

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. 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) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 5) 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. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
 - 3. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
 - 4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 - 5. 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.
 - 6. 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.
 - 7. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 - 8. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
- C. 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 when premises has feeders or branch circuits served by more than one nominal voltage system.
 - 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:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 - 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
- D. Identification for Raceways:

Greenwood Lake Union Free School District R23.00331.00 Identification for Electrical Systems

- 1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet (6.1 m).
- 2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet (6.1 m).
 - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.
 - 1) Field-Painting: Comply with Section 099123 and 099113.
 - 2) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
- 3. Use identification labels or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
- E. Identification for Boxes:
 - 1. Use voltage markers to identify highest voltage present.
 - 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 099123 and 099113 per the same color code used for raceways.
 - 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- F. Identification for Devices:
 - 1. Identification for Communications Devices: Comply with Section 271000.
 - 2. Wiring Device and Wallplate Finishes: Comply with Section 262726.
 - 3. Factory Pre-Marked Wallplates: Comply with Section 262726.
 - 4. Use identification label to identify fire alarm system devices.
 - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
 - 5. 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.
 - 6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
- G. Identification for Luminaires:
 - 1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - c. Seton Identification Products: www.seton.com/#sle.
 - d. Substitutions: See Section 016000 Product Requirements.
 - 2. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.

R23.00331.00

- b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
- 3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically nonconductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch (3 mm) when any dimension is greater than 4 inches (100 mm).
- 4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laseretched text.
- 5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
- 6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Substitutions: See Section 016000 Product Requirements.
 - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 - 1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
 - 2. Legend:
 - a. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch (13 mm).
 - 5. Color:
 - a. Normal Power System: White text on black background.
 - 1) 208Y/120 V, 3 Phase Equipment: White text on Black background.
 - b. Emergency Power System: White text on red background.
- D. Format for Receptacle Identification:
 - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 - 2. Legend: Power source and circuit number or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch (5 mm).
 - 5. Color: Black text on clear background.
- E. Format for Fire Alarm Device Identification:
 - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
 - 2. Legend: Designation indicated and device zone or address.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch (5 mm).
 - 5. Color: Red text on white background.

260553 - 5

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:

R23.00331.00

- Brady Corporation: www.bradyid.com/#sle. 1.
- HellermannTyton: www.hellermanntyton.com/#sle. 2.
- Panduit Corp: www.panduit.com/#sle. 3.
- Substitutions: See Section 016000 Product Requirements. 4.
- Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around Β. 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.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch (3 mm).
- G. Color: Black text on white background unless otherwise indicated.
- 2.04 VOLTAGE MARKERS
 - A. Manufacturers:
 - Brady Corporation: www.bradyid.com/#sle. 1.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - Substitutions: See Section 016000 Product Requirements. 4.
 - Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or В. vinyl snap-around type markers.
 - Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or C. self-adhesive vinyl cloth type markers.
 - Minimum Size: D.
 - Markers for Equipment: 1 1/8 by 4 1/2 inches (29 by 110 mm). 1.
 - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 - Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm). 4.
 - E. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
 - Markers for System Identification: 2.
 - F. Color: Black text on orange background unless otherwise indicated.

2.05 WARNING SIGNS AND LABELS

- A. Manufacturers:
 - Brimar Industries, Inc: www.brimar.com/#sle. 1.
 - 2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
 - Insite Solutions, LLC: www.stop-painting.com/#sle. 3.
 - Seton Identification Products: www.seton.com/#sle. 4.
 - Substitutions: See Section 016000 Product Requirements. 5
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:

R23.00331.00

- 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinvl sians.
- 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
- Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated. 3
- D. Warning Labels:
 - Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-1. 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 (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- Install identification products to be plainly visible for examination, adjustment, servicing, and B. maintenance. Unless otherwise indicated, locate products as follows:
 - Surface-Mounted Equipment: Enclosure front. 1.
 - 2 Flush-Mounted Equipment: Inside of equipment door.
 - Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear 3. access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - Interior Components: Legible from the point of access. 6.
 - Conduits: Legible from the floor. 7.
 - 8. Boxes: Outside face of cover.
 - Conductors and Cables: Legible from the point of access. 9.
 - 10. 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.
- Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or E. wrinkles and edges properly sealed.
- F. Secure rigid signs using stainless steel screws.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- В. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 260553

Greenwood Lake Union Free School District R23.00331.00 Wiring Connections Greenwood Lake UFSD - 2023 CIP 260583 - 1

SECTION 260583 WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 260519 Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 Conduit for Electrical Systems.
- C. Section 260533.16 Boxes for Electrical Systems.
- D. Section 262726 Wiring Devices.
- E. Section 262816.16 Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 Wiring Devices Dimensional Specifications; 2016.
- C. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Wiring Devices: As specified in Section 262726.
- B. Flexible Conduit: As specified in Section 260533.13.
- C. Wire and Cable: As specified in Section 260519.
- D. Boxes: As specified in Section 260533.16.

2.02 EQUIPMENT CONNECTIONS

A. HVAC Equipment:

R23.00331.00

1. Electrical Connection: Flexible conduit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 260583

R23.00331.00

Greenwood Lake UFSD - 2023 CIP 260923 - 1

SECTION 260923 LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Daylighting controls.

1.02 RELATED REQUIREMENTS

- A. Section 260526 Grounding and Bonding for Electrical Systems.
- B. Section 260529 Hangers and Supports for Electrical Systems
- C. Section 260533.16 Boxes for Electrical Systems.
- D. Section 260553 Identification for Electrical Systems: Identification products and requirements.
- E. Section 262726 Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- F. Section 265100 Interior Lighting.

1.03 REFERENCE STANDARDS

- A. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
 - 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:

Greenwood Lake Union Free School District R23.00331.00 Lighting Control Devices

- 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include 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: Include detailed information on device programming and setup.
- G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 3. RAB Lighting, Inc: www.rablighting.com/#sle.
 - 4. Sensor Switch Inc: www.sensorswitch.com/#sle.
 - 5. WattStopper: www.wattstopper.com/#sle.
 - 6. Substitutions: See Section 016000 Product Requirements.
 - 7. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:

Greenwood Lake Union Free School DistrictR23.00331.00Lighting Control Devices

- 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
- 2. Sensor Technology:
 - a. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
- 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
- 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
- 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
- 6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
- 7. Sensitivity: Field adjustable.
- 8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
- 9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, lowvoltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
- C. Wall Switch Occupancy Sensors:
 - 1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - d. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
 - 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
 - a. Products:
 - 1) Lutron Maestro Series; www.lutron.com/#sle.
- D. Ceiling Mounted Occupancy Sensors:
 - 1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - 2. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:

Greenwood Lake Union Free School District R23.00331.00 Lighting Co

- Lighting Control Devices
- a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
- E. Power Packs for Low Voltage Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 4. Load Rating: As required to control the load indicated on drawings.

2.03 DAYLIGHTING CONTROLS

- A. Manufacturers:
 - 1. Hubbell Control Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.Hubbell Control Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.Hubbell Control Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.
 - 2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 3. Sensor Switch Inc: www.sensorswitch.com/#sle.
 - 4. WattStopper: www.wattstopper.com/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
 - 6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.
- C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
 - 1. Sensor Type: Filtered silicon photo diode.
 - 2. Sensor Range:
 - a. Indoor Photo Sensors: 5 to 100 footcandles (53.8 to 1,080 lx).
 - 3. Finish: White unless otherwise indicated.
- D. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
- E. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
 - 1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
 - 2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
 - 3. Control Capability:
 - a. Single Zone Switching Modules: Capable of controlling one programmable channel.
 - b. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.

Greenwood Lake Union Free School District R23.00331.00 Lighting Control Devices

- F. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
 - 1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
 - 2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
 - 3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
 - 4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
- G. Power Packs for Low Voltage Daylighting Control Modules:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - 2. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 3. Load Ratings: As required to control the load indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- 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 openings for outlet boxes are neatly cut and will be completely covered by devices or 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 lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 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.

3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) 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 lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
- G. Provide required supports in accordance with Section 260529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface 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.
- I. Identify lighting control devices in accordance with Section 260553.
- J. Occupancy Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Daylighting Control Photo Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 - 3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- E. Correct wiring deficiencies and replace damaged or defective lighting control devices.
Greenwood Lake Union Free School District R23.00331.00 Lighting Cor

Lighting Control Devices

Greenwood Lake UFSD - 2023 CIP 260923 - 7

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- D. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 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 lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION 260923

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Greenwood Lake Union Free School District R23.00331.00 Wiring Devices Greenwood Lake UFSD - 2023 CIP 262726 - 1

SECTION 262726 WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.

1.02 RELATED REQUIREMENTS

- A. Section 260519 Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- B. Section 260526 Grounding and Bonding for Electrical Systems.
- C. Section 260533.16 Boxes for Electrical Systems.
- D. Section 260553 Identification for Electrical Systems: Identification products and requirements.
- E. Section 260583 Wiring Connections: Cords and plugs for equipment.
- F. Section 260923 Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g, with Amendment.
- C. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 Wiring Devices Dimensional Specifications; 2016.
- 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.

1.04 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.

R23.00331.00

Wiring Devices

- 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 Architect of any conflicts or deviations from 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.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
- 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. GFCI Receptacles: Include information on status indicators.
- E. Project Record Documents: Record actual installed locations of wiring devices.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 Product Requirements, for additional provisions.
 - 2. Extra Keys for Locking Switches: Two of each type.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 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 specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles installed in dwelling units.
- E. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- F. Provide GFCI protection for receptacles installed in kitchens.
- G. Provide GFCI protection for receptacles serving electric drinking fountains.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

- B. Wiring Devices, Unless Otherwise Indicated: White with stainless steel wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with stainless steel wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

2.03 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.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. Wall Switches General Requirements: 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: Industrial specification grade, 20 A, 120/277 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.

2.04 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.
 - 3. 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: Digital fade type with tap on/off control and touch preset adjustment.

2.05 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
 - 6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Receptacles General Requirements: 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, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 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.
 - Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
 - 1. GFCI Receptacles General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 - 2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.06 WALL PLATES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 5. Substitutions: See Section 016000 Product Requirements.
 - 6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. 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. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
- E. Weatherproof Covers for Wet Locations: Gasketed, thermoplastic, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

Wiring Devices

- 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.

3.02 PREPARATION

R23.00331.00

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) 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.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 - 4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- 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 (150 mm) 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 GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- 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.

Greenwood Lake Union Free School District R23.00331.00 Wiring

- Wiring Devices
- 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. Identify wiring devices in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- 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.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

Greenwood Lake Union Free School District R23.00331.00 Enclosed Circu Greenwood Lake UFSD - 2023 CIP 262816.13 - 1

SECTION 262816.13 ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.

1.02 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.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NETA ATS Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within 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 Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of circuit breaker upon request.
- C. Field Quality Control Test Reports.

R23.00331.00

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, installation, and starting of product.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 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 circuit breaker internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.
- E. Substitutions: See Section 016000 Product Requirements.
- F. Source Limitations: Provide enclosed circuit breakers and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- 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 (2,000 m).
 - 2. Ambient Temperature: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- D. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Provide thermal magnetic circuit breakers unless otherwise indicated.
- G. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

Greenwood Lake Union Free School District R23.00331.00 Enclosed Circuit Breakers

- 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- I. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

- A. 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.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 - 1. Provide mechanical lugs unless otherwise indicated.
 - 2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. 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.
- E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed circuit breakers plumb.
- F. Install flush-mounted enclosed circuit breakers so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Identify enclosed circuit breakers in accordance with Section 260553.

3.02 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than _____ amperes. Tests listed as optional are not required.

R23.00331.00

Enclosed Circuit Breakers

D. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.04 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.13

Greenwood Lake Union Free School District R23.00331.00 Interior Lighting Greenwood Lake UFSD - 2023 CIP 265100 - 1

SECTION 265100 INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 260529 Hangers and Supports for Electrical Systems.
- B. Section 260533.16 Boxes for Electrical Systems.
- C. Section 260553 Identification for Electrical Systems: Identification products and requirements.
- D. Section 260923 Lighting Control Devices.
- E. Section 262726 Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS

- A. IES LM-63 Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- B. IES LM-79 Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- C. IES LM-80 Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- D. NECA 1 Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA/IESNA 500 Standard for Installing Indoor Lighting Systems; 2006.
- F. NECA/IESNA 502 Standard for Installing Industrial Lighting Systems; 2006.
- G. NEMA 410 Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Disharge Ballasts; 2020.
- H. NEMA LE 4 Recessed Luminaires, Ceiling Compatibility; 2012 (Reaffirmed 2018).
- I. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 101 Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 924 Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- L. UL 1598 Luminaires; Current Edition, Including All Revisions.
- M. UL 8750 Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

Greenwood Lake Union Free School District R23.00331.00 Interior Lighting

- 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.
- 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
- 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 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. 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.
 - b. Include IES LM-79 test report upon request.
 - 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
- 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.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 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.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.
- C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.
- D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 016000 Product Requirements.

2.02 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 3. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - 4. KURTZON Lighting, Inc; www.kurtzon.com/#sle.
 - 5. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 6. Philips Lighting North America Corporation: www.lightingproducts.philips.com/#sle.
 - 7. RAB Lighting, Inc: www.rablighting.com/#sle.
 - 8. Substitutions: See Section 016000 Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. 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.
- F. 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.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- I. 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.
- J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 3. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- C. 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.
- D. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- G. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- H. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
 - 1. Manufacturers:
 - a. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - b. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - c. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
 - d. Philips Lighting North America Corporation: www.lightingproducts.philips.com/#sle.
 - e. Substitutions: See Section 016000 Product Requirements.
- C. Accessories:
 - 1. Provide compatible accessory high-impact polycarbonate vandal shields where indicated.
 - 2. Provide compatible accessory wire guards where indicated.

2.05 BALLASTS AND DRIVERS

A. Manufacturers:

Greenwood Lake Union Free School District R23.00331.00 Interior Lighting Greenwood Lake UFSD - 2023 CIP

265100 - 5

- 1. Allov LED: www.allovled.com/#sle.
- 2. California Accent Lighting, Inc: www.calilighting.com/#sle.
- 3. General Electric Company/GE Lighting: www.gelighting.com/#sle.
- 4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
- 5. OSRAM Sylvania, Inc: www.osram.us/ds/#sle.
- Philips Lighting North America Corporation: www.usa.lighting.philips.com/#sle. 6.
- Substitutions: See Section 016000 Product Requirements. 7.
- 8. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
- 9. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- Ballasts/Drivers General Requirements: Β.
 - Provide ballasts containing no polychlorinated biphenyls (PCBs). 1.
 - Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal 2. and state ballast efficiency/efficacy standards.
 - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- Dimmable LED Drivers: C.
 - Dimming Range: Continuous dimming from 100 percent to five percent relative light 1. output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed. Wall Dimmers: See Section 262726. a.
 - Daylighting Controls: See Section 260923. b.

2.06 ACCESSORIES

- Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match Α. luminaire or field-painted as directed.
- Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted Β. as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. 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.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 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.

3.03 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. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. 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.
 - In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, 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.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
- I. Suspended Luminaires:
 - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 2. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. 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.
- M. 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.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.

- 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 Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. 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 Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 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.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 017800 Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100

Greenwood Lake Union Free School District R23.00331.00 Structured Cabling Greenwood Lake UFSD - 2023 CIP 271000 - 1

SECTION 271000 STRUCTURED CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Communications system design requirements.
- B. Communications pathways.
- C. Copper cable and terminations.
- D. Communications outlets.
- E. Communications grounding and bonding.
- F. Communications identification.

1.02 RELATED REQUIREMENTS

- A. Section 078400 Firestopping.
- B. Section 260526 Grounding and Bonding for Electrical Systems.
- C. Section 260533.16 Boxes for Electrical Systems.
- D. Section 260553 Identification for Electrical Systems: Identification products.
- E. Section 262726 Wiring Devices.
- F. Section 270533.13 Conduit for Communications Systems.

1.03 REFERENCE STANDARDS

- A. BICSI N1 Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- B. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. TIA-568 (SET) Commercial Building Telecommunications Cabling Standard Set; 2020.
- D. TIA-568.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2018d, with Addenda (2020).
- E. TIA-569 Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- F. TIA-606 Administration Standard for Telecommunications Infrastructure; 2021d.
- G. TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d, with Addendum (2021).
- H. UL 444 Communications Cables; Current Edition, Including All Revisions.
- I. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- J. UL 1863 Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.

- 3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
- 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 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.
- C. Evidence of qualifications for installer.
- 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, installation, and operation of product.
- E. Field Test Reports.
- F. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least 3 years experience manufacturing products of the type specified.
- B. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
 - 1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
 - 2. Supervisors and installers factory certified by manufacturers of products to be installed.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

1.08 WARRANTY

- A. See Section 017800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
 - 1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).
 - 2. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
 - 3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F (0 to 60 degrees C) at relative humidity of 0 to 95 percent, noncondensing.
 - 4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

Structured Cabling

- B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
 - 1. Locate main distribution frame in Telecommunications Room.
- C. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.
 - 1. Locate intermediate distribution frames in Telecommunications Room(s) on each floor.
- D. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.02 PATHWAYS

- A. Conduit: See section 270533.13.
- B. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

2.03 COPPER CABLE AND TERMINATIONS

- A. Manufacturers:
 - 1. CommScope: www.commscope.com/#sle.
 - 2. General Cable Technologies Corporation: www.generalcable.com/#sle.
 - 3. Siemon Company: www.siemon.com/#sle.
 - 4. Substitutions: See Section 016000 Product Requirements.
- B. Provide cables with lead content less than 300 parts per million.
- C. Copper Horizontal Cable:
 - 1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
 - 2. Cable Type Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
 - 3. Cable Capacity: 4-pair.
 - 4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
 - 5. Cable Jacket Color Voice and Data Cable: Blue.
 - 6. Product(s):
 - a. CommScope; SYSTIMAX Twisted Pair Cables; GigaSPEED XL Category 6 U/UTP Cable: www.commscope.com/#sle.
 - b. CommScope; Uniprise Twisted Pair Cables; CS34 Series Category 6 U/UTP Cable: www.commscope.com/#sle.
 - c. General Cable Technologies Corporation; GenSPEED Cables: www.generalcable.com/#sle.
- D. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.
- E. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
 - 1. Performance: 500 mating cycles.
 - 2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
 - 3. Product(s):

R23.00331.00

Structured Cabling

- a. CommScope; SYSTIMAX RJ45 Jacks; MGS400 Series Category 6 U/UTP Modular Jacks: www.commscope.com/#sle.
- b. CommScope; Uniprise RJ45 Jacks; UNJ600 Series Category 6 U/UTP Modular Jacks: www.commscope.com/#sle.
- F. Copper Patch Cords:
 - 1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
 - 2. Patch Cords for Patch Panels:
 - a. Quantity: One for each pair of patch panel ports.
 - b. Length: 3 feet.
 - 3. Product(s):
 - a. CommScope; SYSTIMAX Category 6 U/UTP Patch Cords:
 - www.commscope.com/#sle.
 - b. CommScope; Uniprise Category 6 U/UTP Patch Cords: www.commscope.com/#sle.

2.04 COMMUNICATIONS OUTLETS

- A. Manufacturers:
 - 1. CommScope: www.commscope.com/#sle.
 - 2. Siemon Company: www.siemon.com/#sle.
- B. Outlet Boxes: Comply with Section 260533.16.
 - 1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
- C. Wall Plates:
 - 1. Comply with system design standards and UL 514C.
 - 2. Accepts modular jacks/inserts.
 - 3. Capacity:
 - a. Data or Combination Voice/Data Outlets: 2 ports.
 - 4. Wall Plate Material/Finish Flush-Mounted Outlets: High impact thermoplastic, color to be selected.

2.05 GROUNDING AND BONDING COMPONENTS

- A. Comply with TIA-607.
- B. Comply with Section 260526.

2.06 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.
- B. Comply with Section 260553.

2.07 SOURCE QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Factory test cables according to TIA-568 (SET).

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.

C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

3.02 INSTALLATION OF PATHWAYS

- A. Install pathways with the following minimum clearances:
 - 1. 48 inches (1220 mm) from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
 - 2. 12 inches (300 mm) from power conduits and cables and panelboards.
 - 3. 5 inches (125 mm) from fluorescent and high frequency lighting fixtures.
 - 4. 6 inches (150 mm) from flues, hot water pipes, and steam pipes.

B. Outlet Boxes:

- 1. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of telecommunications outlets provided under this section.
 - a. Mounting Heights: Unless otherwise indicated, as follows:
 - 1) Telephone and Data Outlets: 18 inches (450 mm) above finished floor.
 - b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - c. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
 - d. Locate outlet boxes so that wall plate does not span different building finishes.
 - e. Locate outlet boxes so that wall plate does not cross masonry joints.

3.03 INSTALLATION OF EQUIPMENT AND CABLING

- A. Cabling:
 - 1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
 - 2. Do not over-cinch or crush cables.
 - 3. Do not exceed manufacturer's recommended cable pull tension.
 - 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
 - 1. At Distribution Frames: 120 inches (3000 mm).
 - 2. At Outlets Copper: 12 inches (305 mm).
- C. Copper Cabling:
 - 1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch (12 mm) from point of termination.
 - 2. For 4-pair cables in conduit, do not exceed 25 pounds (110 N) pull tension.
 - 3. Use T568B wiring configuration.
- D. Identification:
 - 1. Use wire and cable markers to identify cables at each end.
 - 2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 BSD Quality Requirements, for additional requirements.
- B. Comply with inspection and testing requirements of specified installation standards.
- C. Visual Inspection:
 - 1. Inspect cable jackets for certification markings.

Greenwood Lake UFSD - 2023 CIP 271000 - 6

- 2. Inspect cable terminations for color coded labels of proper type.
- 3. Inspect outlet plates and patch panels for complete labels.
- 4. Inspect patch cords for complete labels.
- D. Testing Copper Cabling and Associated Equipment:
- E. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION 271000

Greenwood Lake Union Free School DistrictGreenwood Lake UFSD - 2023 CIPR23.00331.00FIRE ALARM SYSTEM (EXISTING SYSTEM)284601 - 1

SECTION 284601 FIRE ALARM SYSTEM (EXISTING SYSTEM)

PART 1 - GENERAL

1.01 SCOPE & RELATED DOCUMENTS

- A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the modifications and additions to the existing Fire Alarm System(s) as shown on the drawings and as herein specified.
- B. The requirements of the conditions of the Contract, Supplementary Conditions and General Requirements, apply to the work specified in this section.
- C. The complete installation is to conform to the applicable sections of NFPA-72, NFPA-71, Local Code Requirements and National Electrical Code with particular attention to Article 760.
- D. Additionally, the entire installed system and all integrated system operations shall be within the guidelines of the SBCCI Standard Building Code.
- E. The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.
- F. The contractor shall provide all required modifications and additions to the existing Fire Alarm System for the removal, relocation of existing devices and addition of new devices. This shall include all additional wiring, devices, modifications to the existing control panel, additional components and modules, addressable cards, testing, troubleshooting and instructions to the owner.

1.02 QUALITY ASSURANCE

- A. Each and all items of the Fire Alarm System shall be listed compatible with the existing system under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment is to be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable
- B. All items shall match and be of the same manufacturer as the existing system.
- C. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer who has been engaged in production of this type (software driven) of equipment for at least ten (10) years, and has a fully-equipped service organization within thirty-five (35) miles of the installation.
- D. All control equipment must have transient protection devices to comply with UL864 requirements.
- E. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.
- F. Supplier shall provide documentation that fire alarm technicians are NICET LEVEL 2 certified (minimum of four).
- G. Suppliers' service organization must have been established in the local area for a minimum of ten (10) years with ten (10) years experience on specific equipment brand supplied.

1.03 SUBMITTALS

A. Submit shop drawings for each piece of equipment specified including complete wiring and connection diagrams.

Greenwood Lake Union Free School District Greenwood Lake UFSD - 2023 CIP R23.00331.00 FIRE ALARM SYSTEM (EXISTING SYSTEM)

- B. All submittals shall be submitted in a single complete brochure, which shall be in the form of a soft cover binder with each group separated be an identified index tab.
- C. Submittals that fail to comply with the above requirements will automatically be rejected.
- D. It is the Contractor's responsibility to provide submittals in an organized and timely manner in order so as not to delay the project schedule and hamper the work of other trades.
- E. Submit certificate of Fire Alarm System operating tests.

PART 2 PRODUCTS

2.01 PERIPHERAL DEVICES

- A. The Contractor shall furnish and install addressable devices that are compatible with the existing Cerberus Pyrotronics fire alarm System
- Β. Devices Required but not limited to:
 - Manual Pull Stations 1.
 - 2 Smoke Detectors
 - **Duct Smoke Detectors** 3.
 - 4. **Combination Speaker/Strobe Stations**
 - Visual Alarm (Strobe) Stations 5.
 - Auxiliary contacts on devices where indicated on drawings. 6.
 - Magnetic fire door holds 7.
 - 8. Power Supplies
 - 9. Addressable Relay modules

2.02 MAGNETIC DOOR HOLDERS

- A. Description: Units shall be listed to UL 228. Units shall be equipped for wall or floor mounting as indicated on plans and are complete with matching door plate and extension arms as required. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source from fire alarm panel. Magnets must develop a minimum of 25 lbs. holding force for any of these voltages.
- Material and Finish: Match door hardware. All final hardware material and finishes must be В. coordinate with the GC.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide and install all devices in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760 A and C. Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760 A and B. Upon completion, the contractor shall so certify in writing to the owner and general contractor.
 - All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall 1. be maintained throughout the installation.
- Β. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- C. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
- D. The manufacturer's authorized representative shall provide on-site supervision of installation.

Greenwood Lake Union Free School DistrictGreenwood Lake UFSD - 2023 CIPR23.00331.00FIRE ALARM SYSTEM (EXISTING SYSTEM)284601 - 3

3.02 TESTING

A. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the contractor in the presence of the owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor.

3.03 WARRANTY

- A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.
- B. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72H guidelines.

END OF SECTION 284601

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SECTION 312000 – SITE GRADING

PART 1 - GENERAL

1.1 WORK DEFINED

A. Work covered by this section includes site grading, stone filling and the construction of embankments.

1.2 RELATED WORK

- A. Section 02000 Excavation, Grading, and Shoring
- B. Section 02110 Clearing and Grubbing
- C. Section 02221 Pipe and Structure Backfill
- D. Section 02250 Soil Compaction
- E. Section 02936 Seeding

1.3 QUALITY ASSURANCE

- A. All finished grades shall be as shown on the Drawings or as specified by the Engineer.
- B. When placing fill or construction embankments, all compaction and soil moisture requirements as delineated in Section 02250 shall be followed.

1.4 SUBMITTALS

- A. Certified copies of all results of maximum density tests and field compaction density tests as required in Section 02250.
- B. Gradations of all materials to be used.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery of borrow materials to the site or stockpiling of spoil on the site shall be done in a manner which will not cause any nuisance or allow spillage of materials from the transporting vehicle on public highways.
- B. Store topsoil separately from all other excavated materials and preserve for reuse.
- C. Materials which are required to be stored shall be stored in an orderly manner and at a sufficient distance away from banks of excavations and trenches to avoid overloading and prevent slides or cave-ins. Do not store materials on, over, or adjacent to structures or utilities which may collapse due to the added weight.
- D. Promptly remove materials not specified to be stored or reused. Burning of materials at the site is not permitted. Such materials shall be disposed of off-site in conformance with applicable legal requirements and in a manner acceptable to the Engineer.
- E. Obstruction of roads, driveways, sidewalks, or interference with drainage along gutters, ditches, or drainage channels with stored material is not permitted. If materials cannot be stored at the site to avoid such obstructions and interferences, they shall be stored away from the site and brought back when and as needed.

1.6 JOB CONDITIONS

- A. Keep ground surfaces well drained, but avoid erosion. Do not place fill on wet grade, in water, or over ice or snow.
- B. Filling with frozen materials or when materials already in place are frozen is not permitted.

1.7 SCHEDULING AND SEQUENCING

- A. Schedule the work with the Engineer and afford him adequate time and space to make all required inspections.
- B. Schedule work to coordinate with the approved testing laboratory so that required tests can be taken.

PART 2 - PRODUCTS

2.1 EARTH FILL MATERIAL

- A. Unless otherwise specified, shown on the Contract Drawings, or directed by the Engineer, all fill material shall be common earth or select granular materials as defined in Section 02000.
- B. To the extent it is available, fill material shall consist of approved on-site materials. When there is insufficient approved materials on-site, import approved additional material from off-site, at no additional cost to the owner.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that all boundaries of temporary and permanent easements and property lines are clearly marked in the field and that the work will not violate these boundaries.
- B. Ascertain and verify the locations and character of structures, underground lines, and subsurface conditions and verify that the work will not adversely affect them.
- C. Verify that grade stakes have been properly and accurately set.
- D. Do not begin operations until conditions are satisfactory.

3.2 STRIP AND STOCKPILE TOPSOIL

- A. Strip topsoil to its full depth within all areas to be excavated or graded and in areas to receive payments, fills, or embankments.
- B. Store topsoil on-site, in storage piles. Keep topsoil separated from all other excavated materials and store free of roots and other undesirable materials.

3.3 DISPOSAL OF MATERIALS

A. Use approved on-site materials to the extent they are available. All excess material shall remain stockpiled on-site for fill.

3.4 SITE GRADING

A. Rough grade the portions of the site which must be raised or lowered in order to properly execute the work under other sections.

- B. Uniformly grade the site to the lines, grades, and elevations shown on the Drawings. Finished surfaces shall be reasonably smooth, compacted, and free from irregular surface changes. Unless otherwise specified, the finish grade shall be equivalent to that ordinarily obtainable from either blade grader or scraper operations.
- C. In unpaved areas, except those to be rip-rapped, lined, or specially treated, smooth the surface sufficiently for application of topsoil. The finished topsoil subgrade shall not be more than one inch above or below the established grade or cross section.
- D. In unpaved areas, the finished grades shown on the Drawings include a layer of topsoil. The thickness of the topsoil is as specified in Section 02936.

3.5 EMBANKMENT CONSTRUCTION

- A. Level off surfaces upon which embankments are to be constructed. Where existing ground is left undisturbed, plow or disk the surface and mix it in with the first layer of embankment material to provide a satisfactory bone.
- B. Ground surfaces sloped steeper than 1 vertical to 4 horizontal shall be plowed, stepped, or broken up to permit bonding of the embankment with the existing surface.
- C. Uniformly place and spread fill in successive horizontal layers not more than 8 inches in compacted depth.
- D. For compaction requirements refer to Section 02250.

3.6 SUBGRADE AND EMBANKMENT PROTECTION

- A. Keep the embankments and excavations shaped and well drained. Where ruts or erosion occur, add additional fill and re-shape and re-compact before placing any subsequent materials.
- B. The storage or stockpiling of material on prepared subgrades is not permitted.
- C. All subgrades will be inspected by the Engineer prior to final surface restoration or finishing.

3.7 DITCHES - SWALES

- A. Accurately cut ditches and swales to the required cross sections and grades. Cut off all roots, stumps, rock, and foreign matter, in the sides and bottoms of ditches and swales, to conform to the required slope, grade, and shape.
- B. Maintain ditches and swales at all times so that they effectively drain. Refill, re-shape, and recompact where ruts or erosion occurs.

3.8 DUMPED STONE FILL (if required)

- A. Place stone fill in a manner so as to produce a reasonably well graded mass of rock with the minimum practicable percentage of voids. The finished stone surface shall be free from objectionable pockets of smaller stones and clusters of larger stones.
- B. Placing stones in layers or dumping by methods likely to cause segregation of the various sizes is not permitted. Obtain the desired distribution of the various sized stones by selectively loading, controlled dumping of successive loads or by other approved means.
- C. Completely fill voids with fine stone or gravel. Rearrange stones by mechanical equipment or by hand to the extent necessary to obtain a reasonably well grade distribution.
- D. The final stone surface shall not exceed 3 inches<u>+</u> from the required grades and elevations. Leave stone fill in a firm stable mass.

3.9 PREPARATION OF PAVEMENT SUBGRADES

- A. Shape the entire subgrade to the required line, grade, and cross section. Remove and dispose of all soft and unsuitable material and replace with an approved material. Remove and dispose of all boulders and ledge rock. Break off to a depth of not less than 6 inches below the subgrade. Fill resulting depressions with an approved material.
- B. Roll subgrade with a roller weighing not less than 10 tons and achieve the required compaction densities specified in Section 02250. Re-shape, wet, and aerate subgrade as required. Compact the entire width of the area to receive payment, plus the areas within five feet of and parallel and adjacent to the edges of the pavement. Compact the full depth of embankments to the required density. Where cuts are encountered, thoroughly roll and compact until no further consolidation is apparent.
- C. When pavements cannot be placed immediately after the preparation of the subgrade, the entire subgrade shall be re-shaped and compacted to the required line, grade, and cross section.
- D. After rolling, the surface of the subgrade shall not show any deviation in excess of 3/8 inch when tested with a 10-foot straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finished subgrade shall not vary more than 0.05' from the established grade and cross section.
- E. Do not disturb the finished subgrade by traffic or other operations and protect and maintain in a satisfactory condition until the overlying pavement is placed.

END OF SECTION

SECTION 312100 – PIPE AND STRUCTURE BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Extent of pipe and structure backfill work includes, but is not limited to the following:
 - 1. Furnish and place backfill for pipe or utility trenches, and facility foundations, to the lines and grades shown on the Contract Drawings.
 - 2. Furnish and place general backfill, engineered backfill and porous backfill under slabs on grade.

1.3 RELATED WORK

- A. Section 02000 Excavation, Grading, and Shoring
- B. Section 02250 Soil Compaction
- C. Section 02270 Erosion Control
- D. Section 02936 Seeding

1.4 SUBMITTALS

- A. Test results for gradation, moisture content (Proctor Tests) or other requirements on the various soil and granular items, from each approved material source, prior to their use on the project.
- B. Copies of measurements and computed volumes of unsuitable material removed shall be submitted to the Engineer.
- C. Details of proposed sheeting, if required, shall be submitted to the Engineer for review and no sheeting shall be installed until written acceptance from the Engineer.

1.5 QUALITY ASSURANCE

- A. If trench widths and depths are exceeded, concrete cradles or other special installation procedures may be required and shall be provided where directed by Engineer. All additional costs, including the cost of redesigns, shall be borne by Contractor.
- B. Moisten or dry backfill to the proper moisture content as determined in accordance with ASTM D1557, Method C in order to obtain proper compaction.
- C. All subgrades shall be approved by Engineer before pipes, structures, and facilities are installed or concrete is placed.
- D. The existing ground elevations as shown on the Drawings are believed to be reasonably correct. The Contractor shall satisfy himself, however, by actual examination of the sites of the work, as to the existing elevations and the amount of work required under this section. No claim shall be made by the Contractor for additional compensation by reason of the fact that conditions are other than as shown.

1.6 JOB CONDITIONS

- A. Provide and maintain suitable temporary crossings over open trenches where necessary to maintain access for other Contractors, the Engineer or general public (if applicable).
- B. Any backfill material over trenches that settle and/or erode during a period of one (1) year after the date of final acceptance shall be repaired by the Contractor upon receipt of written notice from the Engineer, at no expense to the Owner.
- C. The Contractor shall take precautions to protect from harm the work of other contractors on site, existing facilities, as well as adjacent property. The Contractor shall be responsible for all damage or injury done to pipes, structures, pavement, property or persons due to improper placing or compacting of backfill. The Contractor shall repair such damaged property or item to the satisfaction of the property owner, public agency having jurisdiction and/or Engineer at no additional cost the Owner.
- D. When it is necessary to haul material over the streets or pavements, the Contractor shall provide suitable tight vehicles so as to prevent deposits on the streets or pavements. In all cases where any materials are dropped from the vehicles, the Contractor shall clean up the same as often as directed and keep the crosswalks, streets, and pavements clean and free from dirt, mud, stone, and other hauled material.
- E. Flagmen, guards, barricades, lights, services, and other items needed for the protection of persons and property shall be furnished and maintained by the Contractor. Costs for these items shall be included in the prices bid for the Contract.
- F. The Contractor shall remove any waste material or other debris that has accumulated as a result of the work of this section and dispose in conformance with applicable legal requirements and in a manner acceptable to the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The various types of backfill material to be utilized on-site are specified below and shall be used as described unless specifically shown otherwise on the drawings. For backfill at building structures, three (3) types of fill are required as defined here and described below:
 - 1. Condition 1 Ordinary general earth fill or select earth fill. (see Section 02000).
 - 2. Condition 2 Select run-of-bank gravel. (see Type E granular material)
 - 3. Condition 3 Porous run-of-bank gravel. (see Type B granular material)
- B. Mechanical, vibratory, pneumatic tampers or other method as approved by the Engineer shall be required.
- C. Water in sufficient quantity may be required to assure compaction.
- D. Lift thickness, and the compactive capabilities of the equipment used, shall be continually monitored by the Contractor to obtain the compaction efforts required per Section 02250 for all materials used for backfill.
- E. Earth materials (including common earth, general earth and select earth fill) specified for backfill, shall be in accordance with Section 02000 or appropriate N.Y.S.D.O.T. items as indicated on the Contract Drawings.
2.2 GRANULAR ITEMS

A. <u>Type A</u> – Material shall meet the requirements of NYSDOT #2 Coarse Aggregate Section 703-02 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

1 ½ inch	100
1 inch	90-100
¹ / ₂ inch	0-15
No. 200	0-1.0

A. <u>NYSDOT #1 Coarse Aggregate Section 703-02</u> – Material shall meet the requirements of NYSDOT #1 Coarse Aggregate Section 703-02 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

25.0 mm	100
12.5 mm	90-100
6.3 mm	0-15

B. <u>Type B</u> - Material shall meet the requirements of NYSDOT Coarse Aggregate Section 703-2; 50-50 Blend of #1 and #2 as defined in the NYSDOT "Standard Specifications" issued in May 2008 and any subsequent revisions). The material shall meet the following gradation by weight:

Blend	
1 ¹ / ₂ inch	100%
1 inch	95-100%
1/2 inch	45-58%
¹ / ₄ inch	0-15%

C. <u>Type D</u> - Material shall meet the requirements of NYSDOT Concrete Sand Section 703-07 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

3/8 inch	100
No. 4	90-100
No. 8	75-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	1-10
No. 200 (wet)	0-3

D. <u>Type E</u> - Material shall meet the requirements of NYSDOT Item 304.12 Subbase Course Type 2 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

2 inch	100
¹ / ₄ inch	25-60
No. 40	5-40
No. 200	0-10

Type E select granular material is to be used for trench backfill whenever the new water main is installed under paved roads, paved shoulders, paved driveways, paved parking lots, gravel shoulders, gravel driveways, or gravel parking lots. In addition, Type E select granular material is

to be used as trench backfill whenever the centerline of the new water main is located 4 feet or closer to the edge of an asphalt pavement.

- 1. Cost for the use of select granular backfills is to be included in the appropriate water main payment item(s).
- E. <u>Type F</u> Material shall meet the requirements of NYSDOT Item 304.13 Subbase Course Type 3 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

4 inch	100
¹ / ₄ inch	30-75
No. 40	5-40
No. 200	0-10

F. <u>Type I</u> - Material shall meet the requirements of NYSDOT Item 203.0801 Select Granular Fill, Slope Protection Type A as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

Material Size	
24-inch maximum dimension	100
6-inch maximum dimension	90-100
2-inch square sieve	0-30
¹ /4-inch sieve	0-10

G. <u>Type J</u> - Material shall meet the requirements of NYSDOT #1A Coarse Aggregate Section 703-02 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

¹ / ₂ inch	100
¹ / ₄ inch	90-100
1/8 inch	0-15
No. 200	0-1.0

H. <u>Type K</u> - Material shall meet the requirements of NYSDOT #2 Coarse Aggregate Section 703-02 as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

1 ¹ / ₂ inch	100
1 inch	90-100
¹ / ₂ inch	0-15
No. 200	0-1.0

Specify as Screened Gravel Only, NYSDOT Material Designation 703-0203

I. <u>Type L</u> - Material shall meet the requirements of NYSDOT #203.07 Select Granular Fill as defined in the NYSDOT "Standard Specifications" issued in May 2008 (and any subsequent revisions). The material shall meet the following gradation by weight:

4 inch	100
No. 40	0-70
No. 200	0-15

J. <u>Type M</u> - Material shall meet the requirements of NYSDOT Item #204.01 Controlled Low Strength Material (CLSM); NYSDOT Item #204.02 Controlled Low Strength Material (CLSM) (No Fly Ash); 75 kPa to 1030 kPa equivalent to 40 psi to 150 psi. NOTE: Use #204.02 (No Fly Ash) for contact with cast iron or ductile iron pipe.

- K. <u>Underdrain Filter Material</u> Material shall meet the requirements of Item 605.0901, Type 1, as defined in the NYSDOT "Standard Specifications" as issued May 2008 (and any subsequent revisions).
- L. <u>Stone Filling (Light)</u> Material shall meet the gradation requirements for stone filling (light) Item 620.03 as defined in the NYSDOT "Standard Specifications" as issued May 2008 (and any subsequent revisions).
- M. <u>Stone Filling (Medium)</u> Material shall meet the gradation requirements for stone filling (medium) Item 620.04 as defined in the NYSDOT "Standard Specifications" as issued May 2008 (and any subsequent revisions).
- N. Acceptance of all types of fill shall be based on the above requirements, and final acceptance shall be made by the Engineer. Such acceptance or rejection of materials shall be binding upon the Contractor.

2.3 PIPE BEDDING MATERIALS

- A. Ductile Iron Pipe Compacted backfill, suitable native material, with no aggregate larger than 2-inch size.
- B. Polyvinyl Chloride (PVC) Pipe NYSDOT Item 203.25 Sand Backfill.
- C. High Density Polyethelene Pipe NYSDOT Item 203.25 Sand Backfill.
- D. See construction plan details for additional information.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The Contractor shall be responsible for providing all necessary fill materials.
- B. All excavations shall be backfilled to the original surface of the ground or to the lines and grades as shown on the Contract Drawings or as otherwise specified, or directed. Backfilling shall be done with suitable excavated materials as shown on the Contract Drawings or approved by the Engineer, and satisfactorily compacted.
- C. Disturbed pavement, including stone driveways, asphalt driveways, roadways and sidewalks shall be restored in accordance with details, materials and requirements as shown on the plans and to the satisfaction of the engineer.
- D. Trenching and related excavation work shall be executed as detailed in Section 02000.
- E. Excavated material considered by the Engineer to be unsuitable for backfilling shall not be used, and shall be stockpiled or removed from the site according to the following:
 - 1. Unsuitable material shall fall into two specific categories. The first shall be that material which would be unsuitable under any circumstances. Material containing humus, spongy material, roots, stumps, muck, peat, and any other objectionable material. This material shall be disposed of in an approved off-site spoil area.
 - 2. The second category shall consist of material which is unsatisfactory for backfill because of its moisture content at the time of excavation. This material shall be stockpiled in approved areas on the Project site. This stockpiled material, when satisfactory for backfill, as determined by the Engineer, shall be used in other areas lacking backfill.

- F. The Engineer shall be the sole judge of what constitutes unsuitable material and into which category it falls. No extra payment shall be made for any stockpiling, rehandling, transporting or placement of any unsuitable material, the cost shall be included in the price bid. Any deficiency in backfill shall be made up in spoil, if suitable, or by imported material acceptable to the Engineer. No payment shall be made for making up any deficiency; the cost of such shall be included in the price bid.
- G. As required, the Contractor may add sufficient water during compaction to assure a complete consolidation of the material. This work shall be at no additional cost to the Owner. Where, in the opinion of the Engineer, adequate consolidation is not being obtained, density tests may be ordered at the expense of the Contractor.
- H. The Contractor shall make up any settlement of trenches or embankments with suitable material and stabilize at no additional cost to the Owner. This work shall be performed promptly and as directed by the Engineer.

3.2 BACKFILLING OF TRENCHES

- A. All pipes shall be protected from lateral displacement and possible damage resulting from backfill operations through, impact or unbalanced loading, by maintaining the pipe adequately embedded as detailed on the Plans. Except where detailed or due to subsoil conditions that require the use of concrete cradle encasement, all pipe embedment shall be placed so as to insure adequate lateral and vertical stability of the installed pipe during pipe jointing and backfill operations. A sufficient amount of the specified pipe backfill material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted below, on each side, as well as above each pipe laid in accordance with the limits as shown on the Contract Drawings.
- B. Pipe backfill materials placed any point below an elevation of 12 inches above the top of the pipe barrel shall be placed and compacted in layers not to exceed 6 inches in uncompacted depth and shall be done simultaneously and uniformly on both sides of the pipe to the limits as shown on the Contract Drawings. All such materials shall be graded in the trench with hand tools in such a manner that they will be placed uniformly alongside the pipe. The remainder of the trench shall be backfilled with material as shown on the standard details. When placed under pavement, utilities, and other structures this remaining backfill shall be select granular material. Each layer shall be thoroughly compacted to prevent settlement.
- C. Where trenches are constructed in, near, or across roadway ditches or other water courses, the backfill shall be protected from surface erosion.
- D. Trucks or other heavy equipment shall not be operated over pipelines until a minimum of 24 inches of backfill above the crown of the pipe has been placed and properly compacted.
- E. Backfill all excavations to the original surface of the ground or to such other grades as may be shown, specified or directed.
 - 1. Backfill with suitable excavated materials which can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, use select fill as specified or ordered by the Engineer.
 - 2. Refill and compact settlements and repair finished work damaged by settlement at no additional cost to Owner.
- F. Backfill the zone around pipes (under, around and to a depth of 6 inches above the pipe) with suitable excavated material free of sod, debris, excavated rock and stones over 2 inches in diameter. Place the suitable material in by shovel in such a manner as not to damage pipe or appurtenances and in layers not to exceed 6 inches in depth. Compact to 95% maximum modified Proctor density.

- G. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- H. Backfill trenches under streets, roads, driveways, walks, gutters and curbs or other areas requiring structural support with select fill, or as directed by the Engineer.
- I. Place and compact the select fill or native soil in uniform layers not exceeding 6" in compacted depth. Compact to 95% maximum modified Proctor density. Maintain optimum moisture content of backfill materials to attain required compaction density. Use compaction equipment suitable for material excavated, and pipe or appurtenance installed.
- J. For other areas use native soil which was removed in the course of the construction excavations or replacement fill. Distribute stones in the backfill to prevent the formation of voids. Do not incorporate in the backfill stones over 12 inches in any one dimension.
- K. Trenches in open fields, lawn areas and wooded areas, may be backfilled by filling in the entire trench, except for the zone around the pipe and the topsoil when stripped and stockpiled, in one operation and compacting the backfill with construction equipment, leaving the fill mounded slightly over the trench. Maintain the surface over the trench during the guarantee period.

For trenches in areas to be restored under the field restoration item of the bid, backfill to allow for the original depth of the topsoil which was stockpiled. Upon completion of the subsoil backfilling, place the stockpiled topsoil on top of the subsoil. Remove large rocks (10" and above) and boulders from the topsoil. The cost of this work shall be included in the field restoration item of the bid.

- L. Employ a placement method that does not disturb or damage other work. Do not backfill against unsupported foundation walls.
- M. Remove surplus backfill materials from site.
- N. Each day complete fine grading operations of the work completed the previous day in areas other than pavement. In pavement areas, complete fine grading and install temporary asphalt the same day.
- O. Fine grade by leveling disturbed areas to as close to final finish grade as possible, leaving the fill mounded slightly over the trench. Remove all debris and place temporary asphalt as specified in the bid or as directed by the Engineer. Payment for temporary asphalt shall be made under the appropriate item of the bid.

3.3 BACKFILLING AROUND STRUCTURES

- A. Location of Fill Types:
 - 1. Condition 1 In all areas outside of building area to within 6" of finished grade, except at paved, concrete or graveled areas where it is to be brought to an elevation appropriate to allow all subbase, asphalt, or concrete material to be placed to grade as shown on the contract drawings.
 - 2. Condition 2 Fill In all fill areas within the building up to an elevation of 6" below the underside of the slab.
 - 3. Condition 3 Fill Final 6" of fill under slab.
- B. Backfilling around structures shall not be commenced until directed by the Engineer.
- C. Prior to backfilling, a minimum of seven (7) days cure time shall elapse from the placing of castin-place concrete. The Contractor shall comply with any special requirements noted on the Contract Drawings. In no case shall backfill materials be allowed to fall directly on a structure or to damage the structure or its protective coatings.

- D. Backfill around structures shall be deposited in horizontal layers not more than 6- to 8-inches in thickness and shall be compacted by tamping to prevent settlement. Backfill shall be brought up evenly on all sides of structures so as not to subject the structure to unequal loadings. Do not backfill against unsupported walls or structures.
- E. Use least desirable material at bottom of fill, best at top. Evenly distribute stones in fill, none over 3" diameter within top 12" of subgrade. Remove rocks and compact each layer of fill before applying next layer. Slope to prevent ponding of water and to provide drainage away from building(s) and roadways. Dewater as required to prevent water from setting in excavated and graded areas. No backfilling will be allowed in areas full of water.
- F. At all times the Contractor shall maintain and operate proper and adequate surface and subsurface drainage methods to the satisfaction of the Engineer in order to keep the construction site dry and in such condition that placement and compaction of fill may proceed unhindered by saturation of the area. During construction, the surface of the fill area shall be left in such condition that precipitation and/or surface water will run off.
- G. Place underslab base material (Type 3 Fill) after all underslab mechanical lines, etc. have been installed. Protect lines, etc. as required.
- H. Backfill over-excavated areas as indicated in Section 02000.

3.4 SETTLEMENT

A. Repair to proper grade any settlement of slab, pavement, utility structure, lawn, etc. adversely affected by settlement within one (1) year after final acceptance of building at no expense to Owner.

END OF SECTION

SECTION 312200 - TRENCHING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Trenches for pipelines and appurtenances
- B. Maintaining trenches
- C. Encountering underground facilities
- D. Existing structures and pavements within the trench limits
- E. Trees, bushes and plantings
- F. Surplus material
- G. Dust control
- H. Voids under adjacent structures

1.2 RELATED WORK

- A. Section 00800 Supplemental Conditions: Subsurface Investigation
- B. Section 01102 Care and Protection of Property
- C. Section 01105 Traffic Regulation
- D. Section 02221 Pipe and Structure Backfill
- E. Section 02484 Lawns and Grass
- F. Section 02671 Horizontal Directional Drilling
- G. Section 02670 Bores

1.3 DEFINITIONS

- A. Trenching or Excavation
 - 1. Grubbing, stripping, removing, storing and rehandling of all materials of every name and nature necessary to be removed for all purposes incidental to the construction and completion of all the work under construction;
 - 2. All dikes, ditches, flumes, cofferdams, pumping, bailing, draining, well points, or otherwise disposing of water;
 - 3. The removing and disposing of all surplus materials from the excavations in the manner specified;
 - 4. The removing and disposal of all rock materials, after rock blasting, from the trench excavations within the payment limits specified;
 - 5. The maintenance, accommodation, and protection of travel and the temporary paving of highways, roads and driveways;
 - 6. The supporting and protecting of all tracks, rails, buildings, curbs, sidewalks, pavements, overhead wires, poles, trees, vines, shrubbery, pipes, sewers, conduits or other structures or property in the vicinity of the work, whether over or underground or which appear within or adjacent to the excavations and the restoration of the same in case of settlement or other injury;
 - 7. All temporary bridging and fencing and the removing of same.

- B. Earth
 - 1. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds.
- C. Backfill
 - 1. The refilling of excavation and trenches to the line of filling indicated on the Contract Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, watering, puddling, etc., as may be required.
- D. Spoil
 - 1. Surplus excavated materials not required or not suitable for backfill or embankments.
- E. Embankments
 - 1. Fills constructed above the original surface of the ground or such other elevation as specified or directed.
- F. Limiting Subgrade
 - 1. The underside of the pipe barrel for pipelines.
- G. Excavation Below Subgrade
 - 1. Excavation below the limiting subgrade of pipelines.
 - 2. Excavate to such new lines and grades as required when material encountered at the limiting subgrade is not suitable for proper support of pipelines.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Type 1 Select Fill
- B. Type 2 Select Fill
- C. Type 5 Select Fill

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum. Locate all utilities and underground obstructions prior to starting excavations, including cutting pavements.
- B. Cut pavement and pavement base over the proposed trench before excavating for pipeline installation. Utilize a jackhammer, wheel cutter ("Pizza Cutter") or power driven saw. Cut pavement to the required trench width.
- C. Relocate, remove and later restore, or replace existing structures in the proposed trench limits and those structures which would be damaged or impede progress.
- D. Protect the trunks of trees adjacent to the Work that are not to be cut. Tie back overhanging branches and limbs not to be cut to prevent injury from excavating machinery or any other operations related to the work.
- E. Do not cut or remove branches, limbs and roots except for those plantings included in clearing and grubbing areas. In the case of unavoidable damage to plantings, neatly trim the injured portions without splitting or crushing.

- F. Remove and temporarily store in soil, any plants and flowers which would be injured by the work. Replant in their original position after the Work has been substantially completed. Maintain until re-established. Replace with plantings of the same kind, quality and size that existed prior to construction when the original plantings die or their growth, beauty or usefulness is diminished as a result of the work.
- G. Maintain support of existing power, lighting, telephone, traffic control and utility poles adjacent to excavations as required by the owners of the poles.
- H. Do not operate on paved surfaces equipment which has treads or wheels that would cut or damage the pavement.
- I. Avoid damage to existing pavement other than pavement within the limits of the trench. Provide the pads of outriggers with protective covers, or place planks or timbers under the pads to prevent damaged to pavements. No payment shall be made for replacement or restoration of pavements beyond the payment limits which are damaged during the Work.
- J. Strip and stockpile topsoil in areas to be restored as field for eventual redistribution to its original profile location. Strip the entire depth of topsoil to a width of the trench payment limit plus 2 feet or greater as may be required by conditions or other installations. Stockpile topsoil on the parcel of land from which it was stripped at locations approved by the ENGINEER. Remove 10" and larger rocks from the topsoil.

3.2 EXCAVATION

- A. Excavate trenches to the lines and grades specified and as required. Backfill with special granular materials, concrete or other materials as directed by the ENGINEER, any excavated space carried beyond or below the lines and grades shown on the Contract Drawings, or as directed by the ENGINEER. Backfill unauthorized excavations at the CONTRACTOR's expense.
- B. Excavate the trench sides vertically between the centerline of the pipe and an elevation 1 foot above the top of the pipe unless this conflicts with the requirements of OSHA. In the case of rock excavation, excavate to 6 inches below invert elevation of pipe and 12 inches wider than the nominal pipe diameter. Maintain a minimum clearance of 6 inches around the pipe.
- C. Provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and remove all such water as fast as it may collect, in such a manner as shall not interfere with the progression of the work or the proper placing of pipes, or other work.
- D. Prevent damage to surrounding pavement, gutters and structures while excavating.
- E. Furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides and ends of excavations in such manner as to prevent any movement which could, in any way, damage the pipe, structures, or other work; diminish the width necessary for construction; otherwise damage or delay the work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.

In no case will bracing be permitted against pipes or structures in trenches or other excavations.

Drive sheeting vertically with the edges tight together as the excavation progresses, and in such manner as to maintain pressure against the original ground at all times. Design all bracing to maintain sheeting in its proper position.

The adequacy of all sheeting and bracing is the sole responsibility of the CONTRACTOR.

Remove and dispose all material which slides, falls or caves into the established limits of excavations due to any cause whatsoever, at the CONTRACTOR's expense. No extra compensation will be paid to the CONTRACTOR for any materials ordered for refilling the void areas left by the slide, fall or cave-in.

- F. Discontinue machine excavation in the vicinity of pipes, conduits and other underground structures and facilities and complete the excavation with hand tools as required by Industrial Code Rule 753.
- G. When determination of the exact location of a pipe or other underground structure is necessary for completing the work properly, excavate test holes to determine such locations.
- H. When the bottom of any excavation is taken out beyond the limits indicated or prescribed, backfill and compact the resulting void with Type 1 or 2 Select Fill compacted to 95% maximum modified Proctor density.
- I. Remove material which, in the opinion of the ENGINEER, is found to be unsuitable for foundation of the pipeline and appurtenances during excavation. Payment shall be made under the appropriate item of the bid.
- J. Use suitable surplus excavated materials for backfill of excavations in rock or to replace other materials unacceptable for use as backfill except in areas which require select backfill. Surplus excavated materials may be stockpiled at appropriate locations as needed for future use.
- K. Remove from the site all surplus excavated materials not needed.
- L. Replace existing structures (including concrete gutters, concrete sidewalks and curbs that are crossed by the proposed water main) and stone shoulders or other stone areas which are damaged or removed during the Work.
- M. When existing driveway culverts are encountered, replace with adequate size (minimum 12-inch diameter). Methods, materials and alignment to be determined by the applicable highway department.
- N. Minimize the creation and dispersion of dust. Sweep and sprinkle with water as required by conditions.
- O. Completely fill all voids which occur under existing sidewalks, curbs, gutters or other structures during the excavation with Type 5 Select Fill.
- P. Place and maintain a 2" thick layer of compacted temporary asphalt over backfilled trenches until permanent pavement is placed. Materials and workmanship for temporary pavement shall conform to the State of New York Department of Transportation specifications. The plant mix (cold patch or other approved material) shall be suitable for providing a smooth surface for traffic. Temporary pavement, if required, shall be paid for under the appropriate item in the bid.

END OF SECTION

SECTION 312300 - SOIL COMPACTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of soil compaction work includes, but is not limited to the following:
1. Requirements for soils and backfill materials consolidation and compaction.

1.3 RELATED WORK

- A. Section 02000 Excavation, Grading, and Shoring
- B. Section 02221 Pipe Structure and Backfill
- C. Section 02660 Water Distribution Piping
- D. Section 2724 Sanitary Sewer Force Main
- E. Section 02930 Seeding

1.4 QUALITY ASSURANCE

- A. The taking of samples and the performing of field compaction density tests and laboratory maximum density tests shall be done for the Contractor by an approved independent testing laboratory.
- B. Determine optimum moisture content of various soil and granular materials in accordance with ASTM D1557, Modified Proctor Tests.
- C. Provide on-site at least one person who shall supervise the soil compaction operations, and who shall be thoroughly familiar with the various types of compaction equipment, proper compacting techniques and methods, and soils behavior, and who shall direct the compaction operations.
- D. It is the responsibility of the Contractor to select, furnish and properly maintain equipment which will compact the fill uniformly to the required density.

1.5 SUBMITTALS

- A. List of compaction plans of proposed compaction equipment and description.
- B. The results of the laboratory maximum density tests, certified by the testing laboratory for the various soil and granular materials utilized on the job.
- C. All laboratory field compaction test and re-test reports.

1.6 JOB CONDITIONS

- A. Compaction shall not take place in freezing weather or when materials to be compacted are frozen, too wet or moist, or too dry.
- B. Schedule the work to allow ample time for laboratory tests and to permit the collecting of samples and the performing of field density tests during the backfilling and compaction operations.

- C. Protect pipes, structures, and all other subsurface work from displacement or injury during compaction operations.
- D. All operations under this section of the specifications will be subject to continuous inspection by the Engineer and a soils testing laboratory approved by the Engineer. The Engineer and the testing laboratory will determine and be the sole judge of the conformance of materials, workmanship, and compaction with the requirements of the contract documents.

PART 2 - PRODUCTS

2.1 COMPACTION

A. Utilize the proper compaction methods and equipment to suit the soils and conditions encountered.

2.2 LABORATORY TEST REPORTS

- A. As a minimum, the laboratory maximum density testing reports shall contain the following:
 - 1. Laboratory's name.
 - 2. Date, time, and specific location from which sample was taken and name of person who collected the sample.
 - 3. Moisture Density Curve plotted on graph paper to as large a scale as is practical with all points used to derive the curve being clearly visible.
 - 4. Designation of the test method used.
 - 5. The optimum density and moisture content.
 - 6. A description of the sample.
 - 7. The date the test was performed and the person who performed the test.
 - 8. The project name, identification, and contractor's name.
 - 9. The signature of a responsible officer of the testing laboratory certifying to the information contained in the report.
- B. As a minimum, the field compaction density testing reports shall contain the following:
 - 1. Laboratory's name.
 - 2. Date, time, depth, and specific location at which the test was made and the person's name who performed the test.
 - 3. Designation of the test method used.
 - 4. Designation of the material being tested.
 - 5. Test number.
 - 6. In place dry density and moisture content.
 - 7. Optimum density and moisture content.
 - 8. Percentage of optimum density achieved.
 - 9. The project name, identification, and contractor's name.
 - 10. The signature of a responsible officer of the testing laboratory certifying to the information contained in the report.

2.3 OTHER MATERIALS

A. All other materials which are required to achieve adequate compaction shall be as selected by contractor subject to approval of Engineer.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that layers of material are no thicker than the maximum thicknesses specified in other Sections.
- B. Verify that moisture content is nearly optimum.
- C. Do not begin compaction operations until conditions are satisfactory.

3.2 PERFORMANCE

- A. Compaction densities shown are percentages of the maximum density obtainable at optimum moisture content as determined by ASTM D1557, Method C.
- B. Uniformly spread each layer. Moisten or dry each layer of material to achieve optimum moisture content. Unless otherwise specified or directed by Engineer, compact each layer of material to the following required densities:

Location	Modified Proctor Test Density
Under concrete slab, foundations, and footings	95%*
Backfill at Structures	95%
Undercut Backfill	95%
General Fill at Buildings	93%
Structural Engineered Fill at Bldgs	95%
Embankments	95%
Paved Areas	95%
Impervious Barriers	95%
Trench Backfill - Under Traffic Areas (including sidewalks) - Non-Traffic areas	95% 90%
Other Landscaped Areas	90%

*100% for granular material if specified

3.3 FIELD QUALITY CONTROL

- A. Perform a laboratory maximum density test for each type of soil proposed for use or encountered in the work. Determine optimum moisture content in accordance with ASTM D1557, Method C.
- B. Engineer will designate the time, date, and exact location of all field compaction density tests. Field density tests may be ordered by the Engineer at his discretion in accordance with the following average frequencies:
 - 1. <u>General</u>: One test for each type of fill and at each change in material or supplier.

- 2. <u>Structures and Roads</u>: One test for each layer of compacted fill and base material at intervals of approximately 200 feet along structure walls and roadways but not less than one test per 2,000 square feet of pavement area.
- 3. <u>Under Structures, Foundations, Slabs, and Footings</u>: One test for every 75 cubic yards of compacted fill or backfill but not less than two per lift.
- 4. <u>Landscaped Areas</u>: One test per 300 cubic yards of compacted fill or backfill but not less than two per lift.
- C. Field density and moisture testing shall conform to the requirements of ASTM D1556 (sand core) or D2922 and ASTM D3017 (nuclear density). Soils shall be described in accordance with ASTM D2488, Visual-Manual Procedure.
- D. If materials fail to meet its specified compaction, grading, etc., the Contractor shall remove, replace and retest the material until the specified parameters are achieved.
- E. The Contractor is responsible for providing all soils testing and re-testing and shall include all costs in the appropriate items bid.

3.4 COORDINATION

A. Provide all assistance and cooperation during testing and coordinate operations to allow ample time for the required sampling and testing.

3.5 ADJUST AND CLEAN

- A. Replace or repair any pipe, structure, or other work which has been displaced, damaged, or injured.
- B. Compacted soils not meeting compaction densities shall be re-excavated, re-compacted, and retested until all requirements are met. All costs of testing shall be borne by the Contractor.

END OF SECTION

SECTION 312400 – EROSION CONTROL

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 work of this section.

1.2 WORK OF THIS SECTION

A. Work covered in this section includes the control of erosion, siltation, and sedimentation. The Contractor and the Engineer shall work together to determine the need for erosion control.

1.3 RELATED WORK

- A. Section 02000 Excavation, Grading and Shoring
- B. Section 02160 Clearing and Grubbing
- C. Section 02221 Pipe and Structure Backfill
- D. Section 02936 Seeding

1.4 PROJECT REQUIREMENTS

- A. Take every reasonable precaution and do whatever is necessary to avoid any erosion and to prevent silting of rivers, streams, impoundments, and drainage ditches, and swales.
- B. The exposure of uncompleted cut slopes, embankments, trench excavations, and site graded areas shall be kept as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.
- C. Should it become necessary to suspend construction for any length of time, shape all excavated and graded areas in such a manner that runoff will be intercepted and diverted to points where minimal erosion will occur. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, and sedimentation basins, until permanent drainage facilities and erosion control features have been completed and are operative.
- D. Fine material placed or exposed during the work shall be so handled and treated as to minimize the possibility of its reaching any surface waters. Use diversion channels, dikes, sediment traps, or any other effective control measures.
- E. Provide silt stops wherever erosion control measures may not be totally capable of controlling erosion, such as in drainage channels and where slopes may exist.
- F. Before water is allowed to flow in any ditch, swale, or channel, install the permanent erosion control measures in the waterway so that the waterway will be safe against erosion.
- G. Take special precautions in the use of construction equipment to minimize erosion. Do not leave wheel tracks where erosion might begin. Prevent direct discharge from dewatering pumps and surface runoff from the construction sites to storm sewers, culverts, streams or ditches. Intercept and conduct surface runoff and discharge from dewatering pumps to siltation ponds before discharging to natural drainage channels.
- H. Disturbance of lands and waters outside the limits of construction is prohibited, except as may be found necessary and approved by the Engineer.

- I. The requirements of this section also apply to project-related construction activities away from the project site, such as at borrow pits, off-site storage areas, and haul and work roads.
- J. Mulching shall follow the seeding operation by not more than 24 hours.
- K. Should any protective measures employed indicate any deficiencies or erosion taking place, immediately provide additional materials or employ different techniques to correct the situation and to prevent subsequent erosion.
- L. Continue erosion control measures until the permanent measures have been sufficiently established and are capable of controlling erosion on their own.
- M. Comply with all federal, state, and local laws, ordinances, rules, and regulations.

1.5 QUALITY CONTROL

- A. Provide at least one person who shall be present at all times during erosion control operations and who shall be thoroughly familiar with the types of materials being installed and the best methods for their installation and who shall direct all work performed under this section.
- B. Material manufacturers and vendors shall be reputable, qualified firms regularly engaged in producing the required types of materials.
- C. Protect and maintain all areas disturbed by the work, such that erosion is adequately controlled and silt and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

PART 2 - PRODUCTS

2.1 HAY AND STRAW MULCH

- A. General: Hay and straw mulches shall be reasonably free from swamp grass, weeds, twigs, debris, and other deleterious material, and free from rot, mold, primary noxious weed seeds, and rough or woody materials. Mulches containing mature seed of species which would volunteer and be detrimental to the permanent seeding, or would result in overseeding, or would produce growth which is aesthetically unpleasing, is not permitted.
- B. Hay Mulch: Properly aired native hay, Sudan grass hay, broomsedge hay, legume hay, or similar hay or grass mowings. When air-dried in the loose state, the contents of the representative bale shall lose not more than fifteen (15) percent of the resulting air-dry weight of the bale. Apply at the rate of 2 to 3 tons/acre, or at 1.5 tons/acre when a net or a mulch stabilizer is used with the mulch.
- C. Straw Mulch: Threshed plant residue of oats, wheat, barley, rye, or rice from which grain has been removed. Apply at the rate of 2 to 3 tons/acre or at 1.5 tons/acre when a net or a mulch stabilizer is used with the mulch.
- D. Mulch Stabilizers: "TRU-Max SMM" by Finn Corporation applied at 2,500 pounds/acre, "Soiltac" by Soilworks, applied at 40 gallons/acre, or asphalt binder, AASHTO M140, Type SS-1 or RS-1 as applicable, applied at the rate of 400 gallons/acre, or approved equal.
- E. Temporary Type Mulch Nets: Paper yard, approximately 0.05" in diameter, woven in to a net with approximate openings of 7/8" by 1/2" and weighing about 0.20 lbs/sy.
- F. Permanent Type Mulch Nets: plastic or nylon mesh netting with approximate openings of 3/8" by 3/4".

2.2 MATTING/BLANKETS (if required)

- A. Nomenclature: The various materials under this paragraph are sometimes referred to as "matting" and "blankets". These words are interchangeably used throughout this section, but the meanings shall be the same.
- B. Jute Matting: Undyed and unbleached jute yarn woven into a uniform open, plain weave mesh, furnished in rolled strips conforming to the following physical requirements:

Width: 48", ±1" 78 warp ends per width of cloth 41 weft ends per yard

Weight: 1.22-1.80 lbs./LY, ±5%

- C. Excelsior Matting: Uniform web of interlocking wood excelsior fibers with a backing of mulchnet fabric on one side only. The mulchnet shall be woven of either twisted paper chord or cotton cord. Excelsior matting shall be furnished in rolled strips and shall conform to the following physical requirements:
 - Width: $36'', \pm 1''$

Weight: $0.80 \text{ lbs/sy}, \pm 5\%$

- D. Erosion Control Mulching Blanket: EBX Series Erosion Control Blankets by Carthage Mills, "Premier Straw Blanket" by American Excelsior Products, or approved equivalent.
- E. Staples: No. 11 (or heavier) plain iron wire made from at least 12" lengths of wire bent to form "U" of 1¹/₂" to 2" width. Use longer staples for loose soils or where otherwise required.

2.3 HYDROMULCHES (if required)

- A. Hydromulches are not permitted where the slope of the ground surface exceeds 10 percent.
- B. Wood fiber mulch with tackifier, "Terra-Wood" with Tacking Agent III by Terra-Mulch, "Fibermulch II" with Dri-Water Hydro Mix Tackifier, or approved equal. Apply wood fibers at the rate of 500 lbs./acre and tackifier at the rate of 40-45 gallons/acre.
- C. Paper mulch equal to "Second Nature Paper Fiber Mulch" by Central Fiber, "Green Choice EZ Spray Hydraulic Mulch" by Phoenix Paper Products, or approved equal applied at the rate of 1,200 lbs./acre.

2.4 SEED AND SOD FOR EROSION CONTROL

- A. For temporary control: See Section 02936.
- B. For permanent control: See Section 02936.

2.5 HAY BALES FOR EROSION CONTROL

A. Rectangular shaped bales of hay or straw, weighing at least 40 pounds per bale, free from primary noxious weed seeds and rough or woody materials.

2.6 SILT FENCES (if required)

A. Filter cloth shall be FX-11M by Carthage Mills, GT-140 by Skaps Industries, or approved equal and shall meet the following requirements:

1. Silt Fence Fabric:

	Minimum Acceptable	
Fabric Properties	Value	Test Method
Grab Tensile Strength (lbs)	90	ASTM D1682
Elongation at Failure (%)	50	ASTM D1682
Mullen Burst Strength (lbs)	190	ASTM D3786
Puncture Strength (lbs)	40	ASTM D3786
Slurry Flow Rate (gal/min/sf)	0.3	
Equivalent Opening Size	40-80	US Std. Sieve SW-02215
Ultraviolet Radiation Stability (%)	90	ASTM G-26

- B. Other materials shall be a defined on the silt fence detail shown on the Contract Documents.
- C. Pre-assembled silt fence which is complete with U.V. stabilized filter fabric (minimum 36-inch) high-strength polypropylene netting and pre-attached hardwood stakes may also be used. The preassembled reinforced silt fence shall be Envirofence as manufactured by Tencato Mirafi, or approved equivalent.

2.7 STABILIZED CONSTRUCTION ENTRANCE (if required)

- A. Stone Type B Material shall be clean, sound, crushed stone of uniform quality. It shall be a 50-50 mixture of NYSDOT size designation #1 and #2 stone as per NYSDOT Standard Specifications dated May 2008, Section 703-02 (and any subsequent revisions).
- B. Filter cloth designated as Type B meeting New York guidelines for Urban Erosion and Sediment Control for heavy duty haul roads, rough graded, as listed below. Acceptable materials are FX-66 by Carthage Mills, American-made Mirafi 600X by Tencate Mirafi, or approved equal. The filter cloth shall be woven fabric of only continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew; rot resistant and conform to the fabric properties listed below:

Fabric Properties	Rough Graded	Test Method
Grab Tensile Strength (lbs)	220	ASTM D1682
Strength (lbs)		
Elongation at Failure (%)	60	ASTM D1682
Mullen Burst Strength (lbs)	430	ASTM D3786
Puncture Strength (lbs)	125	ASTM D751 modified
Equivalent Opening Size	40-80	US St Sieve
		CW-00215

2.8 CHECK DAMS (if required)

- A. Light Stone Fill Material shall be graded stone filling (light) as designated in Section 02221 of this specification.
- B. The gradation of materials furnished will be accepted or rejected based upon a visual examination of the material by the Engineer.
- C. Filter cloth shall be FX-11M by Carthage Mills, GT-140 by Skaps Industries, or approved equal and shall meet the same requirements as for silt fence described in this section.
- D. The purpose of the check dams shall be to reduce erosion by restricting the velocity of flow in the swale/channel.

2.9 TEMPORARY SEDIMENT TRAP (if required)

- A. Clear, grub and strip the area to be excavated of all vegetation and root mat. Required storage shall be 1,800 cubic feet per acre of drainage area. The complete drainage area shall not exceed 5 acres.
- B. Sideslopes shall be 1:1 or flatter on cut slopes and 2 horizontal to 1 vertical or flatter on fill slopes.
- C. Stone check dam or other pipe outlet with seepage collar shall be provided.

PART 3 - EXECUTION

3.1 HAY AND STRAW MULCHING

- A. Install hay or straw mulch immediately after each area has been properly prepared. When permanent seed or seed for erosion control is sown prior to placing the mulch, place mulch on seeded areas within 24 hours after seeding. Engineer may authorize the blowing of chopped mulch provided that 95 percent of the mulch fibers will be 6" or more in length and that it can be applied in such a manner that there will be a minimum amount of matting that would retard the growth of plants. Hay mulch should cover the ground enough to shade it, but the mulch should not be so thick that a person standing cannot see the ground through the mulch. Remove matted mulch or branches.
- B. Where mild winds may blow the mulch, or when ground slopes exceed 15 percent, or when otherwise required to maintain the mulch firmly in place, apply a system of pegs and strings, a chemical stabilizer, or temporary type netting to the mulch. Unless otherwise directed, remove the strings and netting prior to the acceptance of the work.
- C. Where high winds exist, or heavy rainstorms are likely, or where ground surfaces are steep, or where other conditions require, apply temporary type netting over the mulch and take whatever measures are necessary to maintain the mulch firmly in place.

D. Unless otherwise specified, the use of permanent type netting is not permitted without the prior approval of the Engineer.

3.2 MATTING/BLANKETS - GENERAL (if required)

- A. The use of mulch with matting is not permitted, however, a 4" to 6" overlap of mulch over the edge of matting is permissible.
- B. Prepare surfaces of ditches and slopes to conform to the grades, contours and cross sections shown on the Drawings and finish to a smooth and even condition with all debris, roots, stone, and lumps raked out and removed. Loosen the soil surface to permit bedding of the matting. Unless otherwise noted, seed prior to the placement of the matting.
- C. Unroll matting parallel to the direction of flow of water and loosely drape, without folds or stretching, so that continuous ground contact is maintained.
- D. The ditches and swales, and on slopes, each upslope and each downslope end of each piece of matting shall be placed in a 6" trench, stapled at 12" on center, backfilled, and tamped. Similarly, bury edges of matting along the edges of catch basins and other structures. Engineer may require that any other edge, exposed to more than normal flow of water, be buried in a similar fashion.
- E. Tightly secure matting to the soil by staples driven approximately vertically into the ground, flush with the surface of the matting. In driving the staples, take care not to form depressions or bulges in the surface of the matting.
- F. Decrease the specified spacing of staples when varying factors, such as the season of the year or the amount of water encountered or anticipated, requires additional anchoring.
- G. Refer to the following paragraphs for additional requirements on the placement and stapling of matting.

3.3 JUTE MATTING (if required)

- A. Where strips are laid parallel or meet, as in a tee, they shall be overlapped at least 4". Overlap ends at least 6" shingle fashion.
- B. Space check slots, built at right angles to the direction of flow of water, so that one check slot or one end occurs within each 50 feet of length of slope. Construct check slots by placing a tight fold of matting at least six (6) inches vertically into the ground. These shall be tamped the same as the upslope ends.
- C. Press jute matting onto the ground with a light lawn roller or other satisfactory means.
- D. On slopes flatter than 1:4, place staples not more than 3 feet apart in three rows, for each strip, with one row along each edge and one row alternately spaced down the center. On grades 1:4 or steeper, place staples in the same three rows, but spaced 2 feet. On lapping edges, double the number of staples, with the spacing halved. Ends of matting and all required check slots shall have staples placed every foot. Matting placed adjacent to boulders or other obstructions shall be stapled with no spaces between the staples.
- E. Spread additional seed over jute matting, particularly those locations disturbed by the building of slots.

3.4 EXCELSIOR MATTING (if required)

- A. Where strips of excelsior matting are laid end to end, butt the adjoining ends.
- B. When adjoining rolls of excelsior matting are laid parallel to one another, butt the matting snugly.

C. On slopes flatter than 1:4, place staples not more than 3 feet apart in three rows, for each strip, with one row along each edge and one row alternately spaced down the center. On grades 1:4 or steeper, place staples in the same three rows, but spaced 2 feet apart. Ends of matting shall have staples placed every foot. Matting placed adjacent to boulders or other obstructions shall be stapled with no spaces between the staples.

3.5 EROSION CONTROL MULCHING BLANKET (if required)

- A. Where one roll ends and a second roll begins, the upslope piece shall be brought over the end of the downslope roll so that there is a 12-inch overlap, placed in a 4-inch deep trench, stapled at 12 inches on center, backfilled, and tamped.
- B. On slopes where two or more widths of blanket are applied, the two edges shall be overlapped 4 inches and stapled at 12-inch intervals along the exposed edge of the lap joint.
- C. Staple the body of the blanket in a grid pattern with staples 3 feet on center, each way.

3.6 SEED FOR EROSION CONTROL

- A. Sow seed when soils are moderately dry and when wind does not exceed five miles per hour or as directed by the Engineer.
- B. Areas which will be regraded or otherwise disturbed later during construction may be ordered to be seeded with rye grass to obtain temporary control. The seed shall be sown at the rate of approximately one pound per 1,000 square feet, on the pure live seed basis.

3.7 HAY BALES AND SILT FENCES

- A. Provide hay bales or silt fences, as required, for the temporary control of erosion and to stop silt and sediment from reaching surface waters, adjacent properties, or entering catch basins, or damaging the work.
- B. Stake the hay bales to hold them firmly in place. Use a sufficient number of bales to accommodate runoff without causing any flooding and to adequately store any silt, sediment, and debris reaching them.
- C. Erect silt fences and bury bottom edge in accordance with the manufacturer's recommended installation instructions. Provide a sufficient length of fence to accommodate runoff without causing any flooding and to adequately store any silt, sediment, and debris reaching it.
- D. Maintain and leave hay bales and silt fences in place until permanent erosion control measures have stopped all erosion and siltation.

3.8 STABILIZED CONSTRUCTION ENTRANCES (if required)

- A. Stabilized pads of aggregate underlain with filter cloth shall be constructed as shown on the Contract Drawings.
- B. Filter cloth shall be placed over the entire area to be covered with aggregate prior to placing of the stone.

3.9 CHECK DAMS (if required)

A. Stone filling shall be placed in a manner that will produce a reasonable well-graded mass of stone with smaller fragments filling the space between the larger ones, so as to result in the minimum practicable percentage of voids.

- B. Inspect the check dams after each runoff event. Correct all damage immediately. Replace stones as needed to maintain cross sections of the structure.
- C. Remove sediment accumulated behind the dam as needed to allow swale/channel to drain through the stone check dam and prevent large flows from carrying sediment over the dams.
- D. Removed sediment shall be properly disposed of and in a manner not to erode.

3.10 TEMPORARY SEDIMENT TRAP

- A. Sediment traps shall be maintained throughout the duration of the contract or until the drainage area has been properly stabilized as approved by the Engineer.
- B. Sediment shall be removed and trap restored to its original dimensions when sediment has accumulated to 1/2 the design depth of the trap.
- C. Removed sediment shall be properly disposed of and in a manner not to erode.
- D. Inspect the sediment trap after each runoff event. Correct all damage immediately.

3.11 MAINTENANCE

- A. If any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, or if any temporary erosion and sediment control measures are disturbed, repair them immediately.
- B. If the seed is washed out before germination, repair any damage, refertilize, and reseed.
- C. Maintain mulched and matted areas, silt stops, and other temporary control measures until the permanent control measures are established and no further erosion is likely.
- D. All sediment spilled, dropped, or washed onto the driveway or public right-of-way shall be removed immediately.
- E. Maintain ditches and swales at all times so that they effectively drain. Refill, reshape, and recompact where ruts or erosion occurs.
- F. Maintain areas temporarily seeded including repair of all damages, re-seeding, and refertilizing.

END OF SECTION

SECTION 312500 – ROCK EXCAVATION

PART 1 - GENERAL

1.1 **DESCRIPTION**

A. Work Specified

- 1. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary for rock excavation for construction of structures and pipelines as shown and specified. Disposal of excavated rock material is included in this item.
- 2. This item includes backfill of rock excavations with acceptable materials as defined in other Related Work.

1.2 RELATED WORK

A. Section 02221 - Pipe and Structure Backfill

1.3 SUBMITTALS

- A. Before any rock removal begins, the Contractor shall obtain all permits and licenses required by governing authorities having jurisdiction and supply certified copies to the Engineer.
- B. Submit procedures and list equipment to be used.

PART 2 - PRODUCTS

2.1 **DEFINITIONS**

A. Rock shall comprise material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 0.5 cu. Yd, for excavation and that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.

1. Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.

1.

PART 3 - EXECUTION

3.1 GENERAL

1.

- A. Limits of Rock Excavation
 - Structures:
 - a. The lowest elevation of the structure, manhole, pump station, etc. at each location or as directed by the Engineer.
 - b. The original surface of the rock.
 - c. Vertical planes located 12 inches outside the footing or as shown on the Contract Drawings.
 - 2. Pipe Trenches: Excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

B. The rock shall be uncovered prior to removal in sections acceptable to the Engineer so that it may be measured.

3.2 METHODS OF REMOVAL

- A. Mechanical Method
 - 1. Excavate and remove rock by the mechanical method. Hammer or drill holes and utilize tools, wedges, or expansive disintegration compounds to fracture rock.

3.3 DISPOSAL

- A. The excavated rock shall be disposed of as spoil and shall be replaced with Select material for backfilling.
- B. Correct unauthorized rock removal with backfill material, at the sole expense of the Contractor.

END OF SECTION

SECTION 312600 - DEWATERING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. Work covered by this section includes the maintenance of trenches and structural excavations free of water. The Contractor shall make his own determination as to required dewatering operations necessary to complete the work.

1.2 RELATED WORK

- A. Section 02000 Excavation, Grading, and Shoring
- B. Section 02221 Pipe and Structure Backfill

1.3 QUALITY ASSURANCE

- A. Unless otherwise noted or approved by the Engineer, the placement of work shall be in a dry trench.
- B. The Contractor shall be required to ascertain the complete extent of all permits required governing dewatering operations, and shall be bound by their conditions and provisions.
- C. Conduct operations in a manner which will keep the work free of standing and flowing water and dispose the water so as not to damage or create a nuisance to the work, the public, surface, groundwaters, and adjacent properties.
- D. The accumulation of liquids, ice and snow in excavation, trenches, areas to be graded, and adjacent areas during construction is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all equipment and materials necessary to perform dewatering operations in a safe and satisfactory manner.

2.2 NOISE SUPPRESSION ENCLOSURES (if required)

A. Minimum requirements: 3/8-inch plywood enclosure lined with 2-inch rigid insulation.

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. All water removed from the trenches or excavations by pumping, bailing, siphoning, well-points, or other means shall be disposed of in such a manner so as to avoid damage to the work, work of other Contractors, surface and ground water, persons or property. Unless otherwise permitted by the Engineer, groundwater encountered within the limits of excavation shall be depressed to an elevation not less than 12 inches below the bottom thereof before pipe laying or concreting is started, and shall be so maintained until concrete and joint material have attained adequate strength.
- B. The Contractor shall not discharge water from dewatering operations directly into any line or intermittent stream, channel, wetlands or surface water. The Contractor shall not discharge water from dewatering operations directly into the storm or sanitary sewer system without prior approval

of the Engineer. If in the opinion of the Engineer, water from dewatering operations contains unacceptable amounts of sediment, the water shall be treated by filtration, sedimentation basins, or other methods to reduce the amount of sediment contained in the water to allowable levels, as acceptable to the Engineer, prior to disposal.

C. Upon completion of the section wherein the operations have been performed, the Contractor shall remove from the catch basins, ditches, and swales, all mud, silt, debris, and other accumulations discharged to these various locations. The Contractor is responsible for leaving them in a condition similar to that which existed prior to his operations. Proper control measures shall be employed, so as to minimize siltation and erosion in and adjacent to the area of work.

3.2 **PROTECTION**

- A. Provide adequate protection from the effects of possible uplift due to storm or groundwater where buoyancy might lift installed work or cause joint or structure failure during construction.
- B. Protect the interior of installed work from the entering and accumulation of liquids, ice, and snow. Immediately remove and dispose any accumulation which may occur.

3.3 ADJUST AND CLEAN

A. Adjust, repair, replace, or clean all work, surfaces, and property which may have been damaged as a result of any dewatering operation.

END OF SECTION

SECTION 321216 – ASPHALT CONCRETE PAVING

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 work of this section.

1.2 DESCRIPTION OF WORK

- A. Work of this Section includes but is not limited to:
 - 1. Aggregates
 - 2. Hot Mix Asphalt Concrete
 - 3. Liquid Asphalts
 - 4. Geotextile Support Fabric
- B. Deliver all container materials in manufacturer's standard, unopened containers with labels legible and intact. Store and protect from damage, freezing, or sunlight and heat, if required of individual product.
- C. Store all materials and other items where damage and/or contamination will not occur.

1.3 DEFINITIONS

- A. Pavement Area: The full width of hard bituminous road, parking surfaces, and asphalt sidewalks as shown on the Drawings.
- B. NYSDOT: New York State Department of Transportation
- C. NYSS: New York State Department of Transportation Standard Specifications dated May 1, 2008 (and any subsequent revisions).

1.4 QUALITY ASSURANCE

- A. Provide at least one person who shall be present at all times during the execution of this portion of the work, and who shall be thoroughly qualified and experienced in the placing of the type of pavements specified and who shall direct all work performed under this section.
- B. Comply with the referenced portions of NYSS.
- C. All testing shall be performed by an approved testing laboratory. The Engineer may use the testing laboratory for inspection services.
- D. Use only the materials and job-mix formula approved by the Engineer. Failure to consistently meet the approved job-mix formula shall be sufficient cause for the Engineer to prohibit the use of the asphalt supplier.
- E. All finished paved surfaces shall be smooth, even, and free from surface defects and irregularities. Edges shall be straight, and shall meet existing pavements smoothly. Pavement shall present a smooth, continuous, and workmanlike appearance, free from patch work, rough edges, spalling areas, potholes, depressions, bumps, and other defects. The finished installation shall meet with the complete approval of the Engineer and Owner with respect to appearance as well as structural integrity and other criteria.
- F. Bituminous materials shall not be placed on any soft grade, when the grade is wet, when the temperature of the surface on which the mixture is to be placed is below 45°F, above 95°F, or when

other weather conditions would prevent proper paving of asphalt unless otherwise ordered or approved by the Engineer.

G. All pavement markings shall be placed or restored by the Contractor under ideal conditions.

1.5 SOURCE QUALITY CONTROL

- A. The asphalt plant shall be approved by the Engineer.
- B. All materials and the asphalt plant will be subject to inspections and tests by the Engineer and by the approved testing laboratory.
- C. Submit sieve analysis of each subbase material from each granular material source.
- D. Submit mill analysis of each grade of asphalt from each material source.

1.6 JOB-MIX FORMULA

- A. No paving shall commence until a job-mix formula for each asphalt material to be placed has been submitted to and approved by the Engineer. The required job-mix formula shall be prepared by an approved testing laboratory and shall comply with the NYSS. Provide all testing as required to clearly show that materials meet specification requirements.
- B. If a previously-established job-mix formula is proposed, certified copies of the mix formula and all test reports made within the last six months by a recognized testing laboratory may be submitted. If the formula and test results comply with these specifications and sufficient evidence of compliance is submitted and is acceptable to the Engineer, a new job-mix formula will not be required. If insufficient data exists, the Engineer may request additional testing, or he may require a new job-mix formula.

1.7 SUBMITTALS

- A. Proposed job-mix formula and certified materials tests as required under Paragraph 1.6 shall be submitted.
- B. Name, address and telephone number of the asphalt plant proposed for use and a certification that the proposed source conforms to the requirements of these specifications shall be submitted.
- C. Evidence shall be submitted indicating that all materials meet the necessary requirements as specified herein.
- D. Source quality control information as required in Section 1.5.
- E. Certified test reports on test required under Part 3 of this specification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Hauling equipment shall conform to NYSS. The Contractor is advised that length of haul, manner of haul, temperature of asphalt, and similar criteria, have a direct bearing on the quality and acceptability of the finished pavements. These other criteria shall be properly controlled such that the job mix of asphalt, when placed, is identical to that specified, approved, and as it left the asphalt plant. Segregation of aggregates, whether occasioned by hauling operations, improper mixing at the asphalt plant, or for other reasons, will result in rejection of the pavement. Clusters and pockets of aggregate in the finished pavement surface, with voids surrounding the aggregates, are unacceptable and will be rejected.
- B. Subbase granular materials shall be hauled, placed, and graded in a manner to assure good drainage, to preclude the inclusion of foreign matter and to preserve the gradation.

- C. Deliver all container materials in manufacturer's standard, unopened containers with labels legible and intact. Store and protect from damage, freezing, or sunlight and heat, if required of individual product.
- D. Store all materials and other items where damage and/or contamination will not occur.

1.9 JOB CONDITIONS

- A. Asphalt <u>top</u> course shall be placed only during periods when the temperature and conditions are as specified in 1.4 F. Deviations from this time schedule shall be only as approved by the Engineer.
- B. Asphalt concrete pavement shall be installed upon previous courses which are clean, dry, and free from standing water, and only when weather conditions are suitable.
- C. Defective Pavement: Portions of the completed pavement which are defective in finish, compaction or elevation, or that do not comply in all respects with the requirements of the contract documents, shall be taken up, removed and replaced with suitable material, and properly installed in accordance with the contract documents.

PART 2 - PRODUCTS

2.1 CRUSHED STONE BASE COURSE

A. The subbase course materials shall consist of granular materials as shown on the Contract Drawings and/or as specified in Section 02221. Depth as shown on the Contract Drawings.

2.2 BITUMINOUS PAVEMENT

- A. Bituminous pavement shall be constructed with approved materials as stipulated in NYSS, Section 400. Job-mix formulas shall be formulated and submitted by the Contractor within the general limits imposed by Table 401-1 from the NYSS Section 401.
- B. A binder course shall be placed at a thickness as to produce a required completed thickness when well compacted with a ten (10) ton roller. The material shall be NYSDOT Type 3 Binder. Required completed thickness shall be as shown on the Contract Drawings.
- C. A wearing course shall be constructed on top of the binder course and shall produce the required completed thickness when well compacted with a ten (10) ton roller. The material shall be NYSDOT Type 7F Top. Required completed thickness shall be as shown on the Contract Drawings.
- D. Base course (where required) shall be placed at a thickness as to produce the required completed thickness when well compacted with a ten (10) ton roller. Base course shall be asphalt base Type 1, in accordance with NYSS Section 401. Required completed thickness shall be as shown on the Contract Drawings.
- E. Asphalt tack coat shall conform to NYSS material designation 702-90.
- F. Bituminous sealer shall conform to NYSS material designations 702-05 or 702-3401.

2.3 ASPHALT SIDEWALK (if required)

A. All materials shall be as used for bituminous paving except that they shall be placed to the thicknesses as shown on the contract drawings.

2.4 MIXES

A. All bituminous concrete shall be mixed at the approved asphalt mixing plant in accordance with NYSS.

2.5 **GEOTEXTILE FABRIC (if required)**

A. The geotextile fabric for pavement stabilization shall be American made Mirafi 500X as manufactured by Tencate Mirafi, FX-55 manufactured by Carthage Mills, or approved equal.

2.6 PAVEMENT MARKING PAINT

A. Shall meet NYS DOT Item 727-01 white or yellow pavement marking paint where shown on the contract drawings, except that no glass beads are required.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to the work of this section, verify that all utility, piping and grading work is complete, tested and approved by the Engineer and to the point where pavement installation may be properly performed. Particular attention is given to items such as pipelines or conduits so as to avoid excavating pavements at a later date.
- B. All work shall be performed in conformance with NYSS Section 402 or as otherwise specified or directed by the Engineer.
- C. Joints, where required, due to the discontinuation of work, shall be well bonded and sealed in such a manner as to create an integral appearance. Joints in successive courses shall be offset a minimum of two (2) feet horizontally from the lower pavement course. Transverse and longitudinal joints shall be performed in accordance with NYSS Section 402. Care shall be taken by workmen at all times to avoid walking on freshly spread material.
- D. Where, curbs, pavers, concrete sidewalk, manholes or other objects come in contact with the pavement, they shall receive a uniform coating of an asphalt tack coat. The asphalt coating shall be applied according to the manufacturer's recommendations but in no case shall it be applied above the elevation of the abutting asphalt materials.
- E. All asphalt material shall be placed in a uniform layer by an approved bituminous paver. Hand placement may be permitted in small irregularly shaped areas which are not accessible to a paver, only with prior Engineer approval.
- F. Each day's paving (binder or top) shall begin from a straight saw cut joint approved by the Engineer.
- G. Joints at existing pavements shall be vertically sawcut. Apply tack coat on surfaces as shown on joint detail of Contract Drawings before beginning placement of new material. New material surfaces shall match existing surface.

3.2 SUBGRADE PREPARATION

- A. Subgrade shall be prepared in accordance with Section 02000.
- B. The Engineer may require a field demonstration of compaction equipment before approving subgrade. Rolling and compacting shall be done in the longitudinal direction of the traffic flow. If the moisture content of the soil is outside of the limits required to achieve the required compaction in accordance with Section 02250, the Engineer will require the addition of water or discing and regrading so that the required degree of compaction shall be achieved. Obtain Engineer's approval of subgrade prior to placing subbase course or geotextile fabric (if fabric is required).

3.3 SUBBASE COURSE INSTALLATION

- A. The Contractor shall notify the Engineer at least three days before any subbase material is scheduled to be placed.
- B. Geotextile fabric (if required) shall be placed as specified previously.
- C. Subbase shall be placed to the thickness and limits as shown on the Contract Drawings.
- D. The accepted base material shall be placed with a maximum lift of 6" per course. Each course shall be compacted with a vibratory compactor capable of producing a minimum dynamic vibration force of 27,000 pounds.
- E. Compaction for driveways or roadways shall proceed in the longitudinal direction to traffic flow and be performed in accordance with NYSS Section 304. Compaction for parking areas shall commence on one side of an area and gradually proceed to the opposite side. When rolling has been completed in one direction, the rolling shall commence in a direction 90 degrees from the first rolling.
- F. After completion of rolling, no traffic shall be permitted over the compacted course and no hauling other than necessary for bringing material for next course will be allowed. Each compacted course shall be tested with a straight edge 16 feet in length and any depressions greater than 1/4 inch in depth shall be regraded until the depressions are corrected. The finished surface shall be smooth compact and dry.
- G. All voids in the top subbase course shall be removed by regrading and compacting to the satisfaction of the Engineer.
- H. Thickness tests and compaction tests shall be conducted on the subbase courses. The Contractor shall hand dig holes, not less than 3" in diameter through the subbase, at locations designated by the Engineer. The Engineer shall measure the thicknesses and if any deficiencies are found, they shall be corrected. These tests may be conducted on an average of one test every 200 feet.

3.4 BASE COURSE INSTALLATION (if required)

- A. Asphalt concrete base course, as required by the Contract Documents, shall be placed to thicknesses and limits as shown on the Contract Drawings and only upon an Engineer approved subbase grade.
- B. Compact the base course as specified in NYSS Section 401. In areas where rollers are inaccessible, compaction shall be effected with hand tampers or gas-fired compactors weighing not less than 25 pounds and having a bearing area not greater than 48 square inches.
- C. Care shall be taken when rolling adjacent to a curb, sidewalk, light pole or other structure. Damage to any structure shall be repaired or replaced by the Contractor as ordered by the Engineer at no additional cost to the Owner.
- D. The surface shall be tested with a 16 foot straight edge and all variations exceeding 1/4 inch in height or depth shall be eliminated.

3.5 **BINDER COURSE INSTALLATION**

- A. Asphalt binder shall be placed to the thickness and limits as shown on the Contract Drawings and only upon an Engineer approved subbase grade (where no base course) or approved base course.
- B. The roadway or sidewalk base surface to be covered shall be free from holes, depressions, bumps, waves, and corrugations. Any unsuitable surface areas or where directed by the Engineer shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the correct grade. The roadway surface shall be cleaned by the use of mechanical

sweepers, hand brooms, or other effective means until the surfaces are free of all material which might interfere with the bond between the overlay material and the existing surfaces. All cleaning equipment shall be approved by the Engineer prior to use. Cleaning shall continue until adequate cleaning results as determined by the Engineer. Cleaning shall be done immediately prior to overlaying at no additional cost to the Owner.

- C. Compact the binder course as specified in NYSS Section 401. In areas where rollers are inaccessible, compaction shall be effected with hand tampers or gas-fired compactors weighing not less than 25 pounds and having a bearing area not greater than 48 square inches.
- D. Care shall be taken when rolling adjacent to a curb, sidewalk, light pole or other structure. Damage to any structure shall be repaired or replaced by the Contractor as ordered by the Engineer at no additional cost to the Owner.
- E. The surface shall be tested with a 16 foot straight edge and all variations exceeding 1/4 inch in height or depth shall be eliminated.

3.6 TOP COURSE INSTALLATION

- A. Asphalt top course shall be placed only during the periods indicated in Section 1.9 A.
- B. The roadway or sidewalk binder surface to be covered shall be free from holes, depressions, bumps, waves, and corrugations. Any unsuitable surface areas or where directed by the Engineer shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the correct grade. The roadway surface shall be cleaned by the use of mechanical sweepers, hand brooms, or other effective means until the surfaces are free of all material which might interfere with the bond between the overlay material and the existing surfaces. All cleaning equipment shall be approved by the Engineer prior to use. Cleaning shall continue until adequate cleaning results as determined by the Engineer. Cleaning shall be done immediately prior to overlaying at no additional cost to the Owner.
- C. The Contractor shall coordinate the application of the upper courses for new and existing asphaltic pavements so that the finished surface of both top courses will be uniformly level. Any irregularities or depressions in the existing pavement shall be corrected by placing additional asphaltic concrete.
- D. Roll the asphalt top course with a minimum ten ton roller, or as specified by the NYSS.
- E. The finished pavement shall present a continuous and even appearance from edge of pavement to edge of pavement. The top course shall be blended in to meet existing pavements where applicable.
- F. The surface shall be tested with a 16 foot straight edge and all variations exceeding 1/4 inch in height or depth shall be eliminated.

3.7 MANHOLE CASTINGS AND OTHER APPURTENANCES

A. Manhole frames and covers, valve boxes, cleanout covers, catch basin frames and grates and dry well frames and grates shall be set so that the finished asphalt top course is 1/4 inch above each. In no case shall these frames and covers, boxes or grates protrude above the finish pavement surface. Likewise these appurtenances shall not sit in depressions nor be paved over. Prior to completion of finished pavement, all castings and appurtenances shall be protected from damage by the Contractor.

3.8 GEOTEXTILE FABRIC (if required)

A. The pavement stabilizing fabric shall be placed over subgrade only after the subgrade has been reviewed and limits for fabric established by the Engineer.

- B. The fabric shall be unrolled over the designated subgrade area with a 24" overlap at fabric ends and allowing 12" overlap on sides. Prior to placement of subbase materials the fabric shall be pulled tight leaving no waves in the fabric.
- C. Subbase materials shall be placed on the fabric in such a manner that equipment does not come in contact with the fabric, the fabric remains in tension and no damage to the filter cloth from equipment or subbase materials occurs. All fabric placed shall be covered with fill the same day.
- D. Fabric which becomes damaged prior to covering shall be removed over its full width and replaced with new fabric, overlapping as stated above.

3.9 PAVEMENT MARKINGS

- A. The Contractor shall paint solid lines using two coats of paint in those areas indicated on the contract drawings and as, hereinafter, specified. Lines shall be painted immediately after all aspects of the paving operations have been completed and before dirt can accumulate on the pavement surface.
 - 1. Protection: Install adequate barricades at points where trespassing can occur immediately after paving is completed so as to prevent vehicles or pedestrians from impeding the painting, operation.
 - 2. Method: Carefully layout and define all painted lines on the surface of the pavement by means of chalk markings before painting, and accurately paint all lines within the limits and to the dimensions indicated on the contract drawings. All surfaces must be thoroughly cleaned before lines are painted.
 - 3. All lines shall be clear and distinct with sharply defined edges. Apply two coats of paint. At least 24 hours shall elapse between the painting of the first and second coats.
 - 4. Removal of Equipment: Upon completion of the painting operation and once the paint has dried, remove all barricades and other debris which has resulted from this operation.

3.10 WARRANTY

A. Settlement: Any settlement exceeding 1/8" in 10' or 1/4" total depression, which occurs in any asphalt work within one year after final acceptance, shall be entirely removed and brought to proper grade and repaired, to the satisfaction of the Engineer.

END OF SECTION

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SECTION 329200 – LAWNS AND GRASS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. Work covered by this section includes providing topsoil, seeding, sodding, fertilizer, liming (if required), and mulching all unpaved areas within the grading limits and restoring unpaved areas damaged or disturbed as a result of construction operations.

B. Definitions

- 1. <u>Grass Areas</u>: Areas primarily used as lawns.
- 2. <u>Planted Areas</u>: Areas primarily used as gardens and flower beds, and areas containing ornamental trees, plants, shrubbery, and hedges, and parks, and other areas established for aesthetic purposes.
- 3. <u>Wooded Areas</u>: Areas containing dense growth of trees and shrubs.
- 4. <u>Open Areas</u>: Areas consisting of fields, pastures, and other areas not defined as grass or planted areas.
- 5. <u>Paved Areas</u>: Areas which are paved with gravel, asphalt, concrete, stone, or other paving materials which include, but are not limited to, roads, road shoulders, driveways, side-walks, gutters, patios, recreational courts, railroad beds, and trails.

1.2 RELATED WORK

- A. Section 02000 Excavation, Grading and Shoring
- B. Section 02221 Pipe and Structure Backfill
- C. Section 02270 Erosion Control

1.3 QUALITY ASSURANCE

- A. All work in conjunction with lawns and landscaping shall be performed under the direction of individuals experienced in the establishment of lawns and landscape plantings.
- B. The intent of this section is to provide lawns and landscaped areas of high quality. This section is, therefore, somewhat general in nature, in that the requirements specified herein are the minimum requirements necessary for lawns, sod, and ground cover.
- C. All materials shall meet or exceed the requirements of federal, state, and local laws and ordinances and shall conform to the standards of the Association of Official Agricultural Chemists.
- D. Material manufacturers and vendors shall be reputable, qualified firms regularly engaged in producing the type of material being supplied.
- E. Establish a good stand of grass of uniform color and density.
- F. Sod may be used in lieu of seed and shall be provided where specified, where shown on the Drawings, in areas where the establishment of grass may be difficult due to steep slopes or drainage flows, and where required to prevent erosion.
- G. Protect, maintain, and care for all grassed areas.

1.4 SUBMITTALS

A. If lime is required, submit a lime label containing manufacturer's name, type of lime, weight, and guaranteed analysis.

- B. Proposed seed mixtures and manufacturer's recommended rate of application.
- C. Seed labels containing vendor's name, seed name, lot number, percentage of germination, percentage of purity, percentage of weed seed, and percentage of inerts.
- D. Fertilizer labels containing manufacturer's name, brand name, type, weight, and guaranteed analysis.

1.5 **ENVIRONMENTAL REQUIREMENTS**

Seeding and sodding shall be done during the following times and then only when conditions are A. satisfactory. Seeding: When the ground becomes workable in the spring to June 1 and between August 15 and October 1.

1.6 **GUARANTEE**

- A. All work shall be guaranteed for a minimum of one year from the date of first acceptance of the work or from the date when Engineer determines that Contractor has established a good, vigorous, and healthy stand of grass of uniform color and density, whichever date is later. For sod, the guarantee period is until sod is fully knitted to a depth of one inch (1").
- B. During the guarantee period, replace all dead, unhealthy, or unsightly grass and sod. Also repair all damaged surfaces resulting from the defective grass or sod.
- C. Final acceptance will be given by Owner after established grassed and sodded areas have been in place for one year in a vigorous and healthy condition.

PART 2 - PRODUCTS

2.1 **TOPSOIL** (see Section 02000)

- Approved topsoil, obtained from excavation and grading work or, if insufficient material (either A. quantity and/or quality) is available, it shall be imported. All topsoil shall be 4 inches in depth.
- Store topsoil separately from all other excavated materials on the site and preserve for reuse or B. replace with 4 inches of imported topsoil meeting the requirements of Section 02000.
- C. Stocked or furnished topsoil shall be tested by an approved soil testing laboratory for determination of correct lime and fertilizer additives.

2.2 LIME (to be used to adjust pH to acceptable limits, see Section 02000)

- A. Calcic or dolomitic ground limestone.
- B. Total carbonates - 85% minimum content.
- C. Magnesium oxide - 10% minimum content for dolomitic and high magnesium limes.
- D. Sieve Analysis at least 95% passing the No. 8 sieve at least 40% passing the No. 100 sieve
- E. Coarser material may be used providing the rates of application are increased as approved by the Engineer.
- F. Packaging: New, clean, sealed, and properly labeled bags not exceeding 100 pounds each.
2.3 FERTILIZER

- A. Standard Commercial Grade: dry, free-flowing type suitable for common spreader application or finely-ground, water soluble type suitable for power sprayer application or granular pellet type suitable for application by blower equipment.
- B. Minimum content 10% total nitrogen 6% available phosphoric acid 10% water-soluble potash
- C. Cyanamide compounds and hydrated lime are not permitted in fertilizer mixtures.
- D. Packaging: New, clean, sealed, and properly labeled bags not exceeding 100 pounds each.

2.4 SEED MIXTURES

- A. Grade A quality, fresh and recleaned, and proved to produce satisfactory growth in the locality of the project.
- B. In existing grass areas, mixtures shall be comparable to existing grasses and, when established, shall match as nearly as practicable the existing undisturbed grass.
- C. Seed Mix: Fresh, clean, from current season's crop, delivered in original packages, unopened, bearing guaranteed analysis. Seed shall meet New York State standards of germination and purity.
- D. Lawn seed mix shall be used when existing grass areas (lawns) are disturbed.

COMMON NAMES Erosion Control Mixture Lawn Seed Mix	Proportioned By Weight	Percent Purity	Percent Germination	Max. Weed Seed
Kentucky Bluegrass	45%	85%	80%	0.5%
Red or Chewings Fescue	35%	95%	80%	0.5%
Perennial Ryegrass (fine textured)	20%	85%	80%	0.5%

2.5 SOD (if required)

A. Firm, dense, even textured and showing good root development. Grasses shall be of the type required for the intended use, suitable for the climatic conditions at the project site, and as approved by the Engineer.

2.6 HAY AND STRAW MULCH (see Section 02270)

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that all underground and above ground work has been completed to the point where topsoiling, fertilizing, seeding (or sodding), and mulching operations may properly commence without unnecessary disturbances at a later date.
- B. Verify that seeding and sodding may be completed within the time limitations specified in Environmental Requirements.
- C. Do not commence work under this section until conditions are satisfactory.

3.2 SPREADING TOPSOIL

- A. In areas to be seeded, provide topsoil to a minimum compacted thickness of 4 inches. In the event that sufficient topsoil is not available from stripping the area to be excavated, the Contractor shall import enough additional topsoil to make up the deficit at no additional cost to the Owner.
- B. In areas to be sodded, provide topsoil to a minimum compacted thickness of 2 inches.
- C. Loosen all ground surfaces to a minimum depth of 2 inches to facilitate bonding of the topsoil to the subgrade. Use discs, spike-tooth harrows, or other approved means.
- D. Clean surface of subgrade of all stones, sticks, and rubbish larger than two inches in size and all litter and detrimental materials.
- E. Spread topsoil evenly on the prepared subgrade and lightly compact. Final surface grades shall be as shown on the Drawings and where not shown, the surface shall be graded to the elevations which previously existed and to afford positive drainage of all areas.
- F. Carry out spreading so that turfing operations can proceed with a minimum of soil preparation or tilling. Do not spread topsoil when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work in conformance with all legal requirements in a manner acceptable to the Engineer.
- G. After spreading, break up large, stiff clods and hard lumps, and rake off all stones and rocks larger than 1-inch in size, roots, litter, foreign matter, poisonous materials, and other materials which may be detrimental to the work. Dispose of all such materials off-site.
- H. Remove all topsoil spilled on sidewalks, driveways, and other surfaces for which topsoil is not specified or required.

3.3 PREPARATION OF TOPSOIL

- A. If the following conditions exist at the time of sowing seed or placing sod, fertilizing and liming, this paragraph may be omitted:
 - 1. Topsoil has been spread and raked clean within the past 10 days and is shaped to the required grade.
 - 2. Topsoil has been spread and raked and has been thoroughly loosened and worked to a depth of not less than 3 inches within the past 10 days and shaped to required grade.
 - 3. Topsoil spread more than 10 days ago but the top 3 inches is loose, friable, reasonable free from large clods, rocks, large roots, or other undesirable matter and shaped to the required grade.
- B. If any of the above conditions do not exist, then prepare the topsoil in accordance with the following paragraphs.
- C. Repair all eroded and damaged surfaces, cut or otherwise remove all weeds and grass and scarify or otherwise loosen topsoil to a depth of not less than 3 inches.
- D. Break up large, stiff clods and hard lumps, and rake off all stones and rocks larger than 1-inch in size, roots, litter, foreign matter, poisonous materials, and other materials which may be detrimental to the work. Dispose of all such materials off-site in conformance with all legal requirements and in a manner acceptable to the Engineer.
- E. Remove all topsoil spilled on sidewalks, driveways, and other surfaces for which topsoil is not specified or required.

3.4 LIMING (used when required to adjust pH of topsoil)

- A. Apply separately at the rate of 50 pounds/1,000 square feet, prior to fertilizing, seeding, and sodding. Lime may be applied dry by spreader or as an aqueous solution by spraying.
- B. After application, work lime into the top 3 inches of soil and redress surface to a smooth finish.

3.5 FERTILIZING (DRY)

A. Uniformly spread fertilizer at the rate of 25 pounds/1,000 square feet with a cyclone or broadcasting type spreader.

3.6 SEEDING (DRY)

- A. Sow seed uniformly with a cyclone or broadcasting type spreader at a rate recommended by the seed vendor and as approved by the Engineer. The rate shall be based upon "new lawn" requirements and shall not be less than five pounds per 1,000 square feet.
- B. Sow seed when soils are moderately dry and when wind does not exceed five miles per hour.

3.7 FERTILIZING AND SEEDING (WET - HYDROSEEDING)

- A. Contractor may apply seed and fertilizer by spraying them in the form of an aqueous mixture.
- B. Equipment shall be of a type made specifically for this purpose and capable of maintaining a uniform mixture, even when not spraying.
- C. Water used shall be fresh water free from injurious chemicals and other toxic substances harmful to plant life.
- D. Use high pressure spray, directed upward so that the mixture will fall to the ground like rain in a uniform spray. Spraying which causes, or is likely to cause, damage to property or crops, erosion, or runoff is not permitted.
- E. Application rates shall be as specified in paragraphs 3.5 and 3.6.

3.8 ROLLING

- A. Dry Applications: Roll seeded surfaces after they have been properly covered.
- B. Wet Applications: Roll seeded surfaces if mulch is not used, and then only after soil has dried.
- C. Where rolling is required, compact soil lightly with a lawnroller, immediately after seed is sown.

3.9 MULCHING - GENERAL

- A. In seeded areas, use a mulch, matting, or a blanket to protect the seeding. Apply within 24 hours after the seeding operation is completed.
- B. In general, hay and straw mulching as described in Section 02270 is adequate and required for the protection of all seeding operations.
- C. On slopes steeper than 5 horizontal to 1 vertical, it is recommended to use mulching matting/blankets as described in Section 02270 for erosion control.
- D. The Contractor at his option, however, may use hay and straw mulching but is responsible for all seeding repair due to damage caused by slope erosion.

3.10 SODDING (if required)

- A. Sod may be used in lieu of seed and shall be provided where specified, where shown on the Drawings, in areas where the establishment of grass may be difficult due to steep slopes or drainage flows, and where required to prevent erosion.
- B. Sod shall be moist and placed on prepared surface with the edges in close contact. Stagger joints in adjoining rows and fill any gaps with sod plugs or topsoil.
- C. In ditches and swales, place sod with the longer dimension perpendicular to the flow of water. On slopes, starting at the bottom of the slope, place the sod with the longer dimension approximately parallel to the bottom of the slope.
- D. Water, roll, and tamp exposed edges of sod to give a smooth surface.
- E. On slopes subject to wash, and slopes steeper than 2:1, secure sod with wooden pegs driven at about 24 inches on center in each direction. Drive pegs through sod, perpendicular to the surface, so that the top of pegs are flush with the top of the sod.

3.11 **PROTECTION**

A. Protect all turf areas by erecting temporary fences, barriers, signs and/or other devices to prevent trampling and damage. Also protect all turf areas from erosion, insects, diseases, and fungi.

3.12 MAINTENANCE

- A. Properly maintain all turfed areas by watering, cultivating, weeding, mowing, reseeding, filling eroded areas and all other repairs and replacements until final acceptance of the work.
- B. Reseed all areas where seed has failed to germinate and where seeded areas have been damaged by erosion, people, vehicular traffic or other causes.
- C. After sod has started to grow, resod any areas or portions failing to show life. Resod as often as necessary in order to establish a healthy, growing sod.

END OF SECTION

SECTION 332300 – DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 SECTION INCLUDES

Ductile iron pipe and fittings for water distribution and transmission lines.

1.2 RELATED SECTIONS

Section 02620 – Water Distribution Piping

Section 02675 - Pressure Testing, Flushing, Disinfecting and Health Sampling of Water Mains

1.3 REFERENCES

ANSI/AWWA C104 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.

- ANSI/AWWA C110 Ductile Iron and Gray Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
- ANSI/AWWA C111 Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- ANSI/AWWA C151 Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids.

AWWA C600 Installation of Ductile Iron Water Mains and Appurtenances.

1.4 SUBMITTALS

Product Data: Provide data on pipe materials, pipe fittings, accessories and polyethylene encasement.

Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver, store, protect and handle products to site under provisions of General Conditions.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE

Pipe Specifications

- 1. Pipe: AWWA C151/C104, cement lined: thickness class 52. All ductile iron pipe, joint restraint and fittings shall conform to ANSI/NSF-61. Pipe shall be push-on (tyton) or mechanical joint pipe as manufactured by U.S. Pipe and Foundry or approved equal. All Push on Joints shall require 3 Bronze Wedges. Mechanical joint pipe shall be provided in specific locations as indicated in the contract plans.
- 2. Joints: ANSI/AWWA C111, rubber gasket.
- 3. Cement Lined: ANSI/AWWA C104.
- 4. Joint Restraint: AWWA C111. Joint restraints shall be U.L. listed and Factory Mutual approved to withstand a minimum pressure of 250 psi. The joint restraints shall be provided for ductile iron push on or mechanical joint pipe with twist off indicators and shall be as

manufactured by EBAA Iron Megalug for mechanical joint pipe, U.S. Pipe and Foundry FIELD LOK 350 for push on joint or approved equal.

Fittings Specifications

- 5. Fittings: ANSI/AWWA C110 (full body) or ANSI/AWWA C153 (compact).
- 6. Joints: ANSI/AWWA C111, rubber gasket, mechanical joint, unless otherwise specified.
- 7. Cement Lined: ANSI/AWWA C104.

2.2 Pipe Insulation

Provide Insulation in locations shown of plans

Provide Foamglas insulation manufactured by Pittsburgh Corning Corporation of Pittsburgh, PA. or approved equivalent

Provide Pittwrap insulation jacketing manufactured by Pittsburgh Corning Corporation of Pittsburgh, PA or approved equivalent

2.3 Heat Trace System

Provide BSX, Self Regulating Heating cable with Terminator DP Power connection, splice and end of circuit kit as manufactured by Thermon, Inc. of San Marcos, TX <u>www.thermon.com</u> or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

Verify existing conditions under provisions of General Conditions.

Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

Remove scale and dirt on inside and outside before assembly.

Prepare pipe connections to equipment with flanges or unions.

3.2 INSTALLATION

Maintain separation of water main from sewer and other utilities in accordance with Contract Plans and Specifications along with Dutchess County Department of Health requirements.

Install pipe to indicated elevations, where noted, within tolerance of 5/8 inches.

- Install piping and fittings as per manufacturer's recommendation and in conformance to AWWA C600.
- Provide joints and restraints at each elbow or change of direction of pipe main and for all fittings, valves and hydrants as indicated in the contract plans.

Establish elevations of buried piping to ensure not less than 5 ft of cover.

Provide pipe sleeves and insulation at locations specified in contract plans.

- Assemble push-on joints using lubricant furnished by manufacturer. Guide plain end of pipe into bell until contact is made with gasket and exert sufficient force to drive pipe home until penetration is made to depth recommended by manufacturer.
- Assemble mechanical joints in accordance with the Notes on Method of Installation, AWWA C111, Appendix A. Tighten all bolts by means of torque wrenches such that follower is brought up evenly. When effective sealing is not obtained at the specified torques, disassemble joint clean and reassemble.
- Assemble restrained joints in accordance with manufacturer's instructions. After each joint has been assembled and restrained, retract pipe until slack is removed from joint. When deflection is required at joint, it shall be taken after retraction.

Assemble restrained push-on and mechanical joints in accordance with manufacturer's instructions.

Install Heat Trace cable and accessories as directed by manufacturer.

END OF SECTION

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