



Town of DeWitt

PROJECT MANUAL FOR THE

Willis V. Carrier Park Recreation Center – Phase 3

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Volume 2

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

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PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Install sleeves as new walls are constructed.
- D. Cut sleeves to length for mounting flush with both surfaces.
 - 1. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- E. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Sections.
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Sections.

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves for the following piping-penetration applications:
 - 1. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 220517

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SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

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- b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
2. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 220518

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SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gage, from manufacturer.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Glass.
 - 8. Stem: Aluminum and of length to suit installation.

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- a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

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2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
 - 1. Inlets and outlets of each domestic water heat exchanger.
- J. Install pressure gages in the following locations:
 - 1. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

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3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION 220519

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SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves NPS 4 and larger.
- H. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

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2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded or soldered.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

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3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Two-piece, bronze ball valves with full port and stainless-steel trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Bronze Valves: May be provided with Flanged ends instead of threaded ends.
 - 2. Two-piece, bronze ball valves with full port and stainless-steel trim.

END OF SECTION 220523.12

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SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B16.18 for solder joint.
 - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NSF Compliance: NSF 61 for valve materials for potable-water service.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze, Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:

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- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
- F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

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3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 125, bronze disc with threaded end connections.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron swing check valves, Class 125, metal seats with flanged end connections.

END OF SECTION 220523.14

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Fastener systems.
 - 4. Pipe positioning systems.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
 - 4. Pipe positioning systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material: ASTM C 552, Type II cellular glass with vapor barrier.
- D. For Clevis Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

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2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

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

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

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- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

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11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- J. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- K. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- C. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

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- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- J. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 4. Insert Material: Length at least as long as protective shield.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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3.4 PAINING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

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PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, showing flow direction and complying with ASME A13.1.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or

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space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 2. Sanitary Waste, Condensate and Vent Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

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3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. Yellow
 - 3. Letter Color:
 - a. Black
 - 4. Letter Designation:
 - a. "P"

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

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- E. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

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PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000(Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.

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- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.

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- e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
- 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 1)

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.

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- d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

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2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

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3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.

- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

- E. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

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2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe

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insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

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3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two Insert number locations of threaded strainers, two Insert number locations of welded strainers, three Insert number locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 NEW INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:

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

B. Domestic Hot Water:

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

C. Condensate:

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

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Pipe fittings, Concealed:
 1. PVC: 30 mils thick.
- D. Pipe fittings, Exposed:
 1. PVC: 30 mils thick.

END OF SECTION 220700

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SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service mains.

1.3 DEFINITIONS

- A. LLDPE: Linear, low-density polyethylene plastic.
- B. PE: Polyethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
 - 1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping 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.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 COORDINATION

- A. Coordinate connection to water main with utility company.

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PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: Cement mortar lined, AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Flanges: ASME 16.1, Class 125, cast iron.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - d. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - e. JCM Industries.
 - f. Smith-Blair, Inc.
 - g. Viking Johnson.
 - 2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.
 - b. Center-Sleeve Material: Manufacturer's standard.
 - c. Gasket Material: Natural or synthetic rubber.
 - d. Pressure Rating: 150 psig minimum.
 - 3. Metal Component Finish: Corrosion-resistant coating or material.

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C. Ductile-Iron Deflection Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. EBAA Iron, Inc.
2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - a. Pressure Rating: 250 psig minimum.

2.4 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: Sheet or tube.
3. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, cross-laminated PE film of 0.004-inch minimum thickness.

2.5 GATE VALVES

1. OS&Y, Rising-Stem Gate Valves:

- a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig.
 - 3) End Connections: Threaded.

2. Nonrising-Stem Gate Valves:

- a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80.

2.6 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. U.S. Pipe and Foundry Company.
2. Description: Sleeve and valve compatible with drilling machine.
- a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, metal-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.7 WATER METERS

- A. Water meters shall be purchased by the Plumbing Contractor from the utility and installed by the Plumbing Contractor.

2.8 CURB VALVES

- A. Manufacturers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amcast Industrial Corporation; Lee Brass Co.
 - b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - c. Jones, James Company.
 - d. Master Meter, Inc.
 - e. McDonald, A. Y. Mfg. Co.
 - f. Mueller Co.; Water Products Div.
 - g. Red Hed Manufacturing & Supply.
- B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

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- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Underground Combined Water-Service and Fire-Service-Main Piping NPS 6 to NPS 12 shall be the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.2 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, metal resilient high-pressure, resilient-seated gate valves with valve box.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

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3.4 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- G. Sleeves are specified in Division 22 Section "Common Work Results for Plumbing."
- H. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- J. See Division 21 Sections for fire-suppression-water piping inside the building.
- K. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.5 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:

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1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3.6 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 4. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. MSS Valves: Install as component of connected piping system.

3.8 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.9 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

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3.10 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to existing water main Insert piping system. Use tapping sleeve and tapping valve.
- D. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.11 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.12 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Sections.

3.13 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

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- a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
- b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
- c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
- 2. Specialty valves.
- 3. Escutcheons.
- 4. Sleeves and sleeve seals.
- 5. Wall penetration systems.

B. Related Sections:

- 1. Division 21 Section "Facility Fire - Suppression Water – Service Piping".

1.3 SUBMITTALS

A. Product Data: For the following products:

- 1. Specialty valves.
- 2. Transition fittings.
- 3. Dielectric fittings.
- 4. Flexible connectors.
- 5. Water meters.
- 6. Vacuum breakers.
- 7. Escutcheons.
- 8. Sleeves and sleeve seals.
- 9. Water penetration systems.

B. Water Samples: Specified in "Cleaning" Article.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

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1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than ten days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

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- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

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- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. 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.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

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3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.5 DIELECTRIC FITTING INSTALLATION

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

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

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1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

- D. Install supports for vertical copper tubing every 10 feet.
- E. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

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- b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

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3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
- D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Strainers.
 - 3. Hose bibbs.
 - 4. Backflow preventers.
 - 5. Drain valves.
 - 6. Water hammer arresters.
 - 7. Air vents.
 - 8. Wall hydrants.
 - 9. Water Meter
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.
 - 3. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated Rough bronze.

2.2 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Standard: ASME A112.18.1 for sediment faucets.
 - 2. Body Material: Bronze.
 - 3. Seat: Bronze, replaceable.
 - 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 6. Pressure Rating: 125 psig.
 - 7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

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8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.3 WALL HYDRANTS

A. Vacuum Breaker Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mansfield Plumbing Products LLC.
 - b. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Enclosed with loose key, Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.
10. Vacuum Breaker (Non-Removable)

2.4 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

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B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.5 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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

2.6 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller.
6. End Connections: Threaded for NPS 2 and smaller.
7. Configuration: Designed for horizontal, straight through flow.

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8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Strainer.

B. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.
 - a.
 - b. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

C. Compound-Type Water Meters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Neptune.
 - b. Badger Meter, Inc.
 - c. Hersey.
 - d. Sensus.
2. Description:
 - a. Standard: AWWA C702.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: With integral mainline and bypass meters; totalization meter.
 - d. Registration: In cubic meters as required by utility company.
 - e. Case: Bronze.
 - f. Operating Range: 3/4 to 500 gpm.
 - g. Pipe Connections: Flanged.

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- D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- D. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

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SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure couplings.
 - 3. Encasement for piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Profile Drawings: Show system piping in elevation. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet and to vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- D. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.

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- B. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than ten calendar days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without written permission from Owner's Representative.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS – (Grease Waste)

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.2 PVC PIPE AND FITTINGS

- A. PVC Cellular-Core Sewer Piping:
 - 1. Pipe: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 - 2. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.

2.3 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) or high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black.

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PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- D. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
 - 2. Install piping with 48-inch minimum cover.
 - 3. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
- E. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
 - 1. Hub-and-spigot, cast-iron soil pipe.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.2 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - 2. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
 - 3. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

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- a. Shielded flexible or rigid couplings for pipes of same or slightly different OD.

3.3 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.
- D. Install manhole-cover inserts in frame and immediately below cover.

3.4 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 310513 for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

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1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.6 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to ASTM C 924.
 7. Manholes: Perform hydraulic test according to ASTM C 969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.

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- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

- A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

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1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.

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2.5 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.6 SPECIAL PIPE FITTINGS

- A. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
 - 3. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

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1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- E. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- F. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- G. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

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- C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
- E. Install supports for vertical cast-iron soil piping every 15 feet.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

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4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce smoke into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Pressure must remain constant throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

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- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Roof flashing assemblies.
 - 4. Miscellaneous sanitary drainage piping specialties.
 - 5. Flashing materials.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

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1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Josam Company; Blucher-Josam Div.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 - i. Josam Company; Josam Div.
 - j. Kusel Equipment Co.
 - k. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - l. Josam Company; Blucher-Josam Div.

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

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

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- f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.3.
 - 3. Pattern: Floor drain.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Not required.
 - 6. Anchor Flange: Not required.
 - 7. Clamping Device: Not required.
 - 8. Outlet: Bottom.
 - 9. Coating on Interior and Exposed Exterior Surfaces: Not required.
 - 10. Sediment Bucket: Required in mechanical rooms.
 - 11. Top or Strainer Material: Nickel bronze.
 - 12. Top of Body and Strainer Finish: Nickel bronze.
 - 13. Top Shape: Round in bathrooms, rectangle in mechanical rooms..
 - 14. Dimensions of Top or Strainer: Insert dimensions and describe body, sump, and grate.
 - 15. Top Loading Classification: Medium Duty.
 - 16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 17. Trap Material: Cast iron.
 - 18. Trap Pattern: Standard P-trap.
 - 19. Trap Features: Trap-seal primer valve drain connection.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.
 - 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Stack Flashing Fittings:

- 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

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2. Size: Same as connected stack vent or vent stack.

B. Vent Caps:

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

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

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

C. Fasteners: Metal compatible with material and substrate being fastened.

D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

E. Solder: ASTM B 32, lead-free alloy.

F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.6 SOLIDS INTERCEPTORS

A. Solids Interceptors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

- a. Josam Company; Josam Div.
- b. MIFAB, Inc.
- c. Rockford Sanitary Systems, Inc.
- d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- e. Tyler Pipe; Wade Div.
- f. Watts Drainage Products Inc.
- g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Type: Factory-fabricated interceptor made for removing and retaining sediment from wastewater.

3. Body Material: Cast iron or steel.

4. Interior Separation Device: Screens.

5. Interior Lining: Corrosion-resistant enamel.

6. Exterior Coating: Corrosion-resistant enamel.

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7. Flow Rate: 75 gpm.
8. Inlet and Outlet Size: 3”
9. Mounting: Recessed with extension section as required..

B.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

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- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Solids interceptors.

3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.

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- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

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SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric, mini tank, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.

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- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

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

1.8 WARRANTY

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

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PART 2 - PRODUCTS

2.1 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Electric, mini tank, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eemax.
 - b. Chromalox.
 - c. Or approved equal.
2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 Annex G barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Thermostat.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
4. Support: Bracket for wall mounting.
5. Capacity and Characteristics:
 - a. 6 gallon mini tank.
 - b. Temperature Setting: 110 Degrees.
 - c. Power Demand: 12 amps.
 - d. Electrical Characteristics:
 - 1) Volts: 120.
 - 2) Phases: Single.
 - 3) Hertz: 60.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

- A. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- B. Heat-Trap Fittings: ASHRAE 90.2.
- C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

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- D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- G. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Electric, mini tank, Domestic-Water Heater Mounting: Install electric, heater at least 18 inches above floor on wall bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

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- D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- F. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill electric, domestic-water heaters with water.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

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

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting

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and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION 223300

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SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

- A. Water Closets: Wall mounted, top spud, accessible and standard.
 - 1. Available Manufactures:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Sloan Valve Company;

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2. Bowl:
 - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
 - b. Material: Vitreous china.
 - c. Type: Siphon jet.
 - d. Style: Flushometer valve.
 - e. Height: Standard.
 - f. Rim Contour: Elongated.
 - g. Water Consumption: 1.6 gal. per flush.
 - h. Spud Size and Location: NPS 1-1/2; top.

3. Support:
 - a. Standard: ASME A112.6.1M.
 - b. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.
 - c. Water-Closet Mounting Height: Standard and Handicapped/elderly according to ICC/ANSI A117.1.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Available Manufacturers:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Sloan Valve Company;

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Consumption: 1.6 gal. per flush.
10. Minimum Inlet: NPS 1.
11. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers:
 - a. Bemis Manufacturing Company.
 - b. Church Seats; Bemis Manufacturing Company.

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c. **American Standard.**

2. Material: Plastic.
3. Type: Commercial (Heavy duty).
4. Shape: Elongated rim, open front.
5. Hinge: Self-sustaining, check.
6. Hinge Material: Noncorroding metal.
7. Seat Cover: Not required.
8. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Water-Closet Installation:
 1. Install level and plumb according to roughing-in drawings.
 2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
- B. Support Installation:
 1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
 2. Use carrier supports with waste-fitting assembly and seal.
 3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- C. Flushometer-Valve Installation:
 1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
 4. Install actuators in locations that are easy for people with disabilities to reach.
- D. Install toilet seats on water closets.
- E. Wall Flange and Escutcheon Installation:

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

F. Joint Sealing:

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

3.3 CONNECTIONS

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

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

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

END OF SECTION 224213.13

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SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Lavatories.
 - 2. Faucets.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory: Wheelchair, vitreous china, wall mounted.
 - 1. Available Manufactures:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Sloan Valve Company;

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2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: Slab or wheelchair.
 - c. Nominal Size: Rectangular, 20 by 18 inches.
 - d. Faucet-Hole Punching: One hole.
 - e. Faucet-Hole Location: Top.
 - f. Color: White.
 - g. Mounting: For concealed-arm carrier.
3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with rectangular, steel uprights.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Manual-type, commercial, solid-brass valve.
 1. Available Manufactures:
 - a. Moen.
 - b. T&S Brass.
 - c. Sloan Valve Company;
 2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
 4. Body Type: Single hole.
 5. Body Material: Commercial, solid brass.
 6. Finish: Polished chrome plate.
 7. Mounting Type: Deck, exposed.
 8. Valve Handle(s): Single lever metering.
 9. Spout: Rigid type.
 10. Spout Outlet: Aerator.

2.3 SUPPLY FITTINGS

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

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- E. Operation: Loose key.
- F. Risers:
 - 1. NPS 1/2.
 - 2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces riser.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2 by NPS 1-1/4.
 - 2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

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

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3.3 CONNECTIONS

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

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

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SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Service basins.
- 2. Utility sinks.
- 3. Sink faucets.

1.3 ACTION SUBMITTALS

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

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

1.4 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SERVICE BASINS

- A. Service Basins: Molded Ston, floor mounted.

- 1. Available Manufactures:
 - a. Florestone Products Co., Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Swan Corporation.
- 2. Fixture:

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- a. Standard: IAPMO/ANSI Z124.6.
 - b. Material: Cast polymer.
 - c. Nominal Size: 36 by 36 by 10 inches.
 - d. Tiling Flange: Not required.
 - e. Rim Guard: On all top surfaces.
 - f. Color: Not applicable.
 - g. Drain: Grid with NPS 3 outlet.
3. Mounting: On floor and flush to wall.

2.2 UTILITY SINKS

A. Utility Sinks: Stainless steel, under mounted.

1. Available Manufactures:
 - a. Elkay Manufacturing.
 - b. Just Manufacturing.
 - c. Eagle Group.
2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Ledge back.
 - c. Number of Compartments: One.
 - d. Metal Thickness: 0.050 inch.
 - e. Compartment:
 - 1) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
 - 2) Drain Location: Centered in compartment.
3. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Loose key.
 - 2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe.
4. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2.
 - 2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.

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5. Mounting: On counter with sealant.

2.3 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two-lever-handle mixing valve.
 1. Refer to Plumbing Fixture Schedule on contract Drawing.

2.4 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 1. Exception: Use ball or gate valves if supply stops are not specified with sink.

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2. Install stops in locations where they can be easily reached for operation.

- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.

3.3 CONNECTIONS

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

3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

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SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountain: Painted cast iron or steel, pedestal wheelchair accessible.
 - 1. Cast-Iron or Steel Drinking Fountains:
 - a. [Elkay](#)
 - b. [Haws](#)
 - c. [Halsey Taylor](#)
 - 2. Standards: Comply with ICC A117.1 and NSF 61 Annex G.
 - 3. Pedestal: Round, with side receptor(s).
 - 4. Receptor(s):
 - a. Number: Three.
 - b. Material: Chrome-plated brass or stainless steel.
 - c. Shape: Round.

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- d. Bubbler: One for each receptor, with adjustable stream regulator.
 - e. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
- 5. Controls: Push button.
 - 6. Access to Internal Components: Panel in pedestal.
 - 7. Supply Piping: NPS 1/2 (DN 15) with shutoff valve.
 - 8. Drain Piping: NPS 1-1/2 (DN 40) minimum trap and waste.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains on concrete.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

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3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

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

END OF SECTION 224713

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SECTION 228239.19 – ELECTRIC WALL HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include details of anchorages and attachments to structure and to supported equipment.
 - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 5. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. QMark
 - 2. Trane

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3. Chromalox, Inc.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

- A. Front Panel: Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

- A. Controls: Unit-mounted thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

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2.7 CAPACITIES AND CHARACTERISTICS

- A. Refer to Schedule on Contract Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall unit heaters to comply with NFPA 90A.
- B. Install wall unit heaters level and plumb.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 COORDINATION

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

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

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

2.3 POLYPHASE MOTORS

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

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- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Manufacturer's standard starting characteristic.

2.4 SINGLE-PHASE MOTORS

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

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

B. Related Sections:

1. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

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1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

- a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted steel channel with inturred lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 7. Metallic Coating: Hot-dipped galvanized.

2.3 THERMAL-HANGER SHIELD INSERTS

1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi minimum compressive strength and vapor barrier.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

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2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

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

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- C. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

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3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying equipment.
- B. Use hangers and supports with galvanized metallic coatings for equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- E. Use corrosion-resistant attachments for hostile environment applications.
- F. Hanger-Rod Attachments: Install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.

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7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

END OF SECTION 230529

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Equipment labels.
- 2. Stencils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

- 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- 2. Letter Color: White.
- 3. Background Color: Black.
- 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's unique equipment number.

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- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 STENCILS

- A. Stencils for Ducts:
 - 1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
 - 2. Stencil Material: Aluminum.
 - 3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 - 4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

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- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 15 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

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1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

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PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

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3.2 PREPARATION

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

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

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- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check for proper sealing of furnaces components.
- J. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.

3.6 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.

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- b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Face and bypass damper settings at coils.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Inlet vane settings for variable-air-volume systems.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
- 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Duct, outlet, and inlet sizes.
 - 3. Terminal units.
 - 4. Exhaust fans.
- E. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.

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- e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- F. Round, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- G. Air-Terminal-Device Reports:
- 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.

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- g. Space temperature in deg F.

3.7 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of each air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, outdoor air.
 - 2. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities

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having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.

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- c. Knauf Insulation; Friendly Feel Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap.
- e. Owens Corning; SOFTR All-Service Duct Wrap.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

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- b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.

2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

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2.6 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

- A. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:

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- 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.

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- b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.8 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Keep insulation materials dry during application and finishing.
- F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- G. Install insulation with least number of joints practical.

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- H. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- J. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

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

3.5 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, outdoor air.
2. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

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

3.6 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Exposed, round outdoor air duct insulation shall be one of the following:
 1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

END OF SECTION 230713

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.

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6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

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2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

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2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation; Insulation Group.
- b. Johns Manville.
- c. Knauf Insulation.
- d. Owens Corning.
- e. Maximum Thermal Conductivity:

- 1) Type I, Flexible: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating.

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Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

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- a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

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2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

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- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 2. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 3. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

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3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 3. Test for leaks before applying external insulation.
 - 4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 5. Give seven days' advance notice for testing.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Disconnect and reconnect ducts as needed for cleaning and inspection.
 - 2. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Furnace unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Supply-air ducts, dampers, actuators, and turning vanes.
 - 5. Dedicated exhaust and ventilation components.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

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2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Provide drainage and cleanup for wash-down procedures.
5. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Supply Ducts:
 1. Ducts Connected to Furnaces:
 - a. Pressure Class: Positive 2-inch wg.
- C. Return Ducts:
 1. Ducts Connected to Furnaces:
 - a. Pressure Class: Positive or negative 2-inch wg.
- D. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 1. Ducts Connected to Furnaces:
 - a. Pressure Class: Positive or negative 2-inch wg.
- F. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Duct Liner:
 1. Supply Air Ducts: Fibrous glass, Type I, 1-1/2 inches thick.

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2. Return Air Ducts: Fibrous glass, Type I, 1-1/2 inches thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

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- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.
- I. Branch Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Flexible connectors.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

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PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Pottorff.
 - g. Ruskin Company.
 - h. Trox USA Inc.
 - i. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 0.064-inch- thick, galvanized sheet steel.
 - b. Mitered and welded corners.

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- c. Flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064-inch-thick.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
 - a. Nylon.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
 - 1. Size: 0.5-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
 - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Pottorff.
 - g. Ruskin Company.
 - h. Trox USA Inc.
 - i. Vent Products Company, Inc.

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- B. L24 volt Actuator Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 - 1. Hat shaped.
 - 2. 0.094-inch- thick, galvanized sheet steel.
 - 3. Mitered and welded corners.
- D. Blades:
 - 1. Multiple blade with maximum blade width of 6 inches.
 - 2. Parallel- and opposed-blade design.
 - 3. Aluminum.
 - 4. 0.064 inch thick single skin.
 - 5. Blade Edging: Closed-cell neoprene.
- E. Blade Axles: 1/2-inch- diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
 - 1. Oil-impregnated bronze.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.5 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing.
 - 4. Ventfabrics, Inc.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

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- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.

END OF SECTION 233300

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof ventilators.
 - 2. Ceiling exhaust fans

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.

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4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

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PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck (Basis of Design).
 2. Loren Cook Company.
 3. Penn Ventilation.
- B. Description: Belt-driven and direct-driven centrifugal fans (as indicated) consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories. Where applicable, unit shall have UL construction suitable for restaurant hood exhaust service.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
 2. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 24 inches or as indicated on plans and in Schedule.
 3. Pitch Mounting: Manufacture curb for roof slope.
 4. Metal Liner: Galvanized steel.

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- H. Capacities and Characteristics:
 - 1. Refer schedule on Contract Drawings.
- I. Electrical Characteristics:
 - 1. Refer to schedule on Contract Drawings.

2.2 CEILING-MOUNTED VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck (Basis of Design).
 - 2. Loren Cook Company.
 - 3. Penn Ventilation.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Plastic louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
 - 1. Isolation: Rubber-in-shear vibration isolators.
 - 2. Manufacturer's standard wall cap and transition fittings.

2.3 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.

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- B. Secure roof mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Sections for installation of roof curbs.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install to power ventilators clear of adjacent equipment and/or structure to allow space for service and maintenance.
- C. Ground equipment according to Division 26 Sections.
- D. Connect wiring according to Division 26 Sections.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual, automatic volume control and fire dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
 - 12. Deliver spare drive belts to owner and obtain receipt.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan, motor pulleys, and drive belts as required to achieve design airflow.
- E. Lubricate bearings.
- F. Assist testing, adjusting and balancing technician in obtaining fan tables required for test procedures in balancing of fan systems.

END OF SECTION 233423

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Square ceiling diffusers.
2. Fixed face registers and grilles.

B. Related Sections:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

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- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Hart & Cooley Inc.
 - d. Krueger.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Price Industries.
 - h. Titus.
 - i. Tuttle & Bailey.
- B. Refer to Grille Register and Diffuser Schedule on Contract Drawings:

2.2 REGISTERS AND GRILLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Hart & Cooley Inc.
 - d. Krueger.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Price Industries.
 - h. Titus.
 - i. Tuttle & Bailey.
- B. Refer to Grille Register and Diffuser Schedule on Contract Drawings:

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

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SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Listed grease ducts.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Grease ducts.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
 - 2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.
- C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

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1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED GREASE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Metal Products; MASCO Corporation.
 - 2. FAMCO.
 - 3. Heat-Fab, Inc.
 - 4. Industrial Chimney Company.
 - 5. LSP Products Group, Inc.
 - 6. Metal-Fab, Inc.
 - 7. Schebler Co. (The).
 - 8. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - 9. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
 - 10. Tru-Flex Metal Hose Corp.
 - 11. Van-Packer Company, Inc.
- B. Description: Double-wall metal vents tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 3-inch annular space filled with high-temperature, ceramic-fiber insulation.
- D. Inner Shell: ASTM A 666, Type 304 stainless steel.
- E. Outer Jacket: Aluminized steel where concealed. Stainless steel where exposed.

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- F. Accessories: Tees, elbows, increasers, hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters and drain fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Listed Grease Ducts: Type I commercial kitchen grease duct.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- E. Lap joints in direction of flow.
- F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.
- G. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

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- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

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SECTION 237333.16 - INDOOR, INDIRECT, GAS-FIRED HEATING AND VENTILATING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes indirect, gas-fired heating and ventilating units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and configuration of indoor, indirect, gas-fired heating and ventilating unit.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
 - 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."
- C. Shop Drawings: For each type and configuration of indoor, indirect, gas-fired heating and ventilating unit.
 - 1. Signed, sealed, and prepared by or under the supervision of a qualified professional engineer.
 - 2. Include plans, elevations, sections, and details.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Detail fabrication and assembly of gas-fired heating and ventilating units, as well as procedures and diagrams.
 - 5. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 6. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
 - 7. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Startup service reports.

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- B. Sample Warranty: For manufacturer's special warranty.
- C. Seismic Qualification Data: Certificates, for indoor, indirect, gas-fired heating and ventilating units, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For indirect-fired heating and ventilating units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each unit.
 - 2. Fan Belts: One set(s) for each unit.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of indirect, gas-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CaptiveAire Systems.
 2. Greenheck Fan Corporation.
 3. Modine Manufacturing Company.
 4. Rapid Engineering, Inc.
 5. REZNOR, a brand of Nortek Global HVAC.
 6. Weather-Rite, a brand of Specified Air Solutions.

2.2 SYSTEM DESCRIPTION

- A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, [filters,]and indirect-fired gas burner to be installed inside the building.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings:
1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
 2. Casing Joints: Sheet metal screws or pop rivets, factory sealed with water-resistant sealant.
 3. Factory Finish for Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.
 4. Air-Handling-Unit Mounting Frame: Formed structural channel supports, designed for low deflection, welded with integral lifting lugs.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Configuration: Horizontal unit with horizontal discharge for suspended installation.
- C. Cabinet: Galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. Duct flanges at inlet and outlet.
- D. Outer Casing: 0.0598-inch- thick steel with enamel-painted finish over corrosion-resistant-treated surface in color to match fan section.
- E. Inner Casing:
1. Burner Section Inner Casing: 0.0299-inch steel.

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2. Internal Insulation: Fibrous-glass duct lining, neoprene coated, comply with ASTM C 1071, Type II, applied on complete unit.
 - a. Thickness: 1 inch.
 - b. Insulation Adhesive: Comply with ASTM C 916, Type I.
 - c. Density: 1.5 lb/cu. ft.
 - d. Mechanical Fasteners: Galvanized steel suitable for adhesive, mechanical, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

- F. Discharge Section: Insulated front-discharge plenum.

- G. Casing Internal Insulation and Adhesive:
 1. Materials: ASTM C 1071, Type I.
 2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the heating-coil section.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive, mechanical, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric, depending on service-air velocity.
 3. Location and Application: Encased between outside and inside casing.

- H. Inspection and Access Panels and Access Doors:
 1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
 2. Inspection and Access Panels:
 - a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
 3. Access Doors:
 - a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 4. Locations and Applications:
 - a. Fan Section: Doors.

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- b. Access Section: Doors.
- c. Mixing Section: Doors.

2.4 SUPPLY-AIR FAN

- A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, self-aligning, permanently lubricated ball bearings.
- B. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.
- C. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with spring isolators.
- D. Fan-Shaft Lubrication Lines: Extended to a location outside the casing.

2.5 AIR FILTERS

- A. Comply with NFPA 90A.
- B. Disposable Panel Filters: Factory-fabricated, flat-panel-type, disposable air filters with holding frames, with a MERV 8 according to ASHRAE 52.2.
 - 1. Thickness: 1 inch.
 - 2. Media: Interlaced fibers.
 - 3. Frame: Galvanized steel.

2.6 DAMPERS

- A. Outdoor-Air and Return-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at a differential pressure of 2-inch wg.
- B. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

2.7 INDIRECT-FIRED GAS BURNER

- A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47, "Gas-Fired Central Furnaces," and with NFPA 54, "National Fuel Gas Code."
 - 1. CSA Approval: Designed and certified by and bearing label of CSA.
 - 2. Burners: Stainless steel.
 - a. Gas Control Valve: Modulating.
 - b. Fuel: Propane gas.
 - c. Minimum Combustion Efficiency: 80 percent.
 - d. Ignition: Electronically controlled electric spark with flame sensor.

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- B. Venting: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.
- C. Combustion-Air Intake: Separate combustion-air intake and vent terminal assembly.
- D. Heat Exchanger: Stainless steel.
- E. Heat-Exchanger Drain Pan: Stainless steel.
- F. Safety Controls:
 - 1. Vent Flow Verification: Differential pressure switch to verify open vent.
 - 2. Control Transformer: 24-V ac.
 - 3. High Limit: Thermal switch or fuse to stop burner.
 - 4. Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
 - 5. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
 - 6. Gas Manifold: Safety switches and controls complying with ANSI standards and FM Global.
 - 7. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
 - 8. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
 - 9. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.8 UNIT CONTROL PANEL

- A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
- B. Control Panel: Surface-mounted remote panel, with engraved plastic cover, and the following lights and switches:
 - 1. On-off-auto fan switch.
 - 2. Heat-vent-off switch.
 - 3. Supply-fan operation indicating light.
 - 4. Heating operation indicating light.
 - 5. Thermostat.
 - 6. Damper position potentiometer.
 - 7. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
 - 8. Safety-lockout indicating light.
 - 9. Enclosure: NEMA 250, Type 1.

2.9 CONTROLS

- A. Control Devices:

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1. Remote Setback Thermostat: Adjustable room thermostat without temperature readout.
 2. Fire-Protection Thermostats: Fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature.
 3. Timers: Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.
 4. Timers: Solid-state, programmable time control with four separate programs; 24-hour battery carryover; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.
 5. Ionization-Type Smoke Detectors: 24-V dc, nominal; self-restoring; plug-in arrangement; integral visual-indicating light; sensitivity that can be tested and adjusted in place after installation; integral addressable module; remote controllability; responsive to both visible and invisible products of combustion; self-compensating for changes in environmental conditions.
 6. Smoke detectors, located in supply and return air, shall stop fans when the presence of smoke is detected.
- B. Fan Control: Interlock fan to start with exhaust fan(s) to which this heating and ventilating unit is associated for makeup air.
- C. Fan Control: Timer starts and stops indirect-fired heating and ventilating unit and exhaust fan(s).
1. Smoke detectors, located in supply and return air, shall stop fans when the presence of smoke is detected.
- D. Mixed Outdoor- and Return-Air Damper Control: When fan is running, outdoor- and return-air dampers shall modulate to supply minimum outdoor air as follows:
1. Minimum 30 percent outdoor air.
 2. Outdoor-air quantity adjusted by potentiometer on control panel.
- E. Temperature Control: Operates gas valve to maintain supply-air temperature.
1. Operates gas valve to maintain space temperature with wall-mounted, field-wired sensor with temperature adjustment, and adjustment on remote-control panel.
 2. Timer shall select remote setback thermostat to maintain space temperature at 50 deg F.
 3. Burner Control: 20 to 100 percent modulation of the firing rate. 10 to 100 percent with dual burner units.

2.10 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Enclosure: Open, dripproof.
 2. Enclosure Materials: Cast iron.

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3. Efficiency: Premium efficient.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of indirect-fired heating and ventilating units.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Verify cleanliness of airflow path to include inner-casing surfaces, filters, coils, turning vanes, fan wheels, and other components.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code" and the International Fuel Gas Code.
- B. Install controls and equipment shipped by manufacturer for field installation with indirect-fired heating and ventilating units.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 1. Gas Piping: Comply with requirements in Section 231126 "Facility Liquefied-Petroleum Gas Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.
- B. Drain: Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to condensate drain pans under condensing heat exchangers.
- C. Where installing piping adjacent to heating and ventilating units, allow space for service and maintenance.
- D. Duct Connections: Connect supply and return ducts to indirect-fired heating and ventilating units with flexible duct connectors. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
- E. Ground equipment according to Division 26 Sections.

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- F. Connect wiring according to Division 26 Sections.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Units will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - a. Inspect for visible damage to burner combustion chamber.
 - b. Inspect casing insulation for integrity, moisture content, and adhesion.
 - c. Verify that clearances have been provided for servicing.
 - d. Verify that controls are connected and operable.
 - e. Verify that filters are installed.
 - f. Purge gas line.
 - g. Inspect and adjust vibration isolators.
 - h. Verify bearing lubrication.
 - i. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - j. Adjust fan belts to proper alignment and tension.
 - k. Start unit according to manufacturer's written instructions.
 - 2. Complete startup sheets and attach copy with Contractor's startup report.
 - 3. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 4. Operate unit for run-in period recommended by manufacturer.
 - 5. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 - 6. Calibrate thermostats.
 - 7. Adjust and inspect high-temperature limits.
 - 8. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
 - 9. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

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10. Measure and record airflow. Plot fan volumes on fan curve.
11. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:
 - a. High-limit heat.
 - b. Alarms.
12. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
13. Verify drain-pan performance.
14. Verify outdoor-air damper operation.

3.6 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heating and ventilating units.

END OF SECTION 237333.16

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- 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. General Cable
 - 2. Senator Wire and Cable
 - 3. Southwire
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

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- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway Armored cable, Type AC Metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

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3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

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3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. Sports Lighting circuiting.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems and exterior lighting foundations, based on NETA MTS and NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

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1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. ILSCO.
 - 4. O-Z/Gedney; A Brand of the EGS Electrical Group.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

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2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

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3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
 - 1. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

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- b. Perform tests by fall-of-potential method according to IEEE 81.
- 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 - 3. Pad-Mounted Equipment: 5 ohms.
 - 4. Manhole Grounds: 10 ohms.
- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.

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3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

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1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

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- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To New Concrete: Bolt to concrete inserts.
 - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Existing Concrete: Expansion anchor fasteners.
 - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

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- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Surface raceways.
 - 4. Boxes, enclosures, and cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allied Tube & Conduit.
 - 2. O-Z/Gedney.

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3. Robroy Industries.
 4. Southwire Company.
 5. Thomas & Betts Corporation.
 6. Western Tube and Conduit Corporation.
 7. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. EMT: Comply with ANSI C80.3 and UL 797.
- D. FMC: Comply with UL 1; zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. LFNC: Comply with UL 1660.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Screw-cover type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Wiremold / Legrand.
 - 2. Panduit Corp.
 - 3. Hubbell

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- G. Gangable boxes are allowed.
- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

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I. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Concealed Conduit, Aboveground: EMT.
2. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

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- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

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- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.

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- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

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- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, minimum 48” below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Direct-buried conduit, ducts, and duct accessories.
- 2. Handholes and boxes.

1.3 DEFINITIONS

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

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

- 1. Include duct-bank materials, including separators and miscellaneous components.
- 2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
- 3. Include accessories for manholes, handholes, boxes, and other utility structures.
- 4. Include warning tape.

- B. Shop Drawings:

- 1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole frame support rings.
 - e. Include grounding details.
- 2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.

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- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
- B. Product Certificates: For concrete and steel used in precast concrete manholes, as required by ASTM C 858.
- C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 36 inches below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.

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2.2 CONDUIT

- A. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- B. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
 - 1. Color: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC."
 - 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
 - 7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 8. Handholes 24 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers made of polymer concrete.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

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1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.
- B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer concrete frame and cover, SCTE 77, Tier 15 structural load rating.
 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 structural load rating.

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4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- F. Duct Entrances to Manholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting

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- near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch.
3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- I. Pulling Cord: Install 100-lbf- test nylon cord in empty ducts.
- J. Direct-Buried Duct Banks:
1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
 2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 3. Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
 4. Depth: Install top of duct bank at least 24 inches below finished grade unless otherwise indicated.
 5. Set elevation of bottom of duct bank as indicated on drawings.
 6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
 7. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 8. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 9. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

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- a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
- K. Warning Tape: Bury warning tape approximately 12 inches above all duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- E. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:

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1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

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2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 2. Sealant shall have VOC content acceptable to or less than that of which is calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.

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- B. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

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1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

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2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: COMMUNICATIONS.
 - 4. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 5. Thickness: 4 mils.
 - 6. Weight: 18.5 lb/1000 sq. ft..
 - 7. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.

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- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 CABLE TIES

- A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.

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- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box with self-adhesive vinyl labels with the wiring system legend and system voltage.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.

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- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for buried cables in raceway.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.

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Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label with clear protective overlay. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Enclosed switches.
 - f. Push-button stations.
 - g. Contactors.
 - h. Remote-controlled switches and control devices.

END OF SECTION 260553

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

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1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.

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3. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344.
- B. Enclosures: Surface-mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 3. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel Same finish as panels and trim.
 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.

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- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression type.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- 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. Eaton / Cutler Hammer.
 - 2. General Electric.
 - 3. Siemens
 - 4. Square D
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Lug only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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1. Eaton / Cutler Hammer.
2. General Electric.
3. Siemens
4. Square D

- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407 NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407 NEMA PB 1.1.

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- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

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D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Snap switches.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

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1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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. Hubbell Inc.
 - 2. Leviton Mfg.
 - 3. Pass & Seymour / Legrand
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through type, duplex 125V, 20A.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

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2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:

2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

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2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

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- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

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SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. LED: Light-emitting diode.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. Recessed Fixtures: Comply with NEMA LE 4.
- D. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- E. CRI of minimum 80. CCT of 4100 K.
- F. Rated lamp life of 50,000 hours.
- G. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- J. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear anodized finish.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.

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2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
1. Extruded-aluminum housing and heat sink.
 2. Clear anodized finish.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:

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1. Secure to any required outlet box.
 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Fixture Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of the Architect.

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END OF SECTION 265119

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SECTION 265668 - EXTERIOR ATHLETIC LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for the Town of DeWitt Carrier Park Phase II Sports Lighting project using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.
- C. The sports lighting will be for the following venues:
 - 1. Baseball Fields
 - 2. Softball Fields
 - 3. Multipurpose Fields
- D. The primary goals of this sports lighting project are:
 - 1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
 - 2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
 - 3. Cost of Ownership: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
 - 4. Control and Monitoring – To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.
 - a. Control and monitoring system shall provide contactor control of all existing circuits. Key switches shall be provided to provide field-level control of existing circuit groups.

1.2 ONFIELD LIGHTING PERFORMANCE

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting manufacturers will provide a guarantee that light levels will be sustained over the life of the warranty period. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below.

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Manufacturers will provide lumen maintenance data of the LED luminaires used per TM-21-11 and will incorporate the lumen maintenance projections into the lighting designs to ensure target light levels are achieved throughout the guaranteed period of the system. Per IES guidelines, lumen maintenance hours should be reported based on the 6x multiplier of testing hours.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Baseball 1 and 2 In-fields	50fc	2:1	25	30.0' x 30.0'
Baseball 1 and 2 Out-fields	30fc	2.5:1	100	30.0' x 30.0'
Softball 3 Infield	50fc	2:1	25	20.0' x 20.0'
Softball 3 Outfield	30fc	2:1	94	20.0' x 20.0'
Softball 5 and 6 Infields	50fc	2:1	25	20.0' x 20.0'
Softball 5 and 6 Out-fields	30fc	2.5:1	82	20.0' x 20.0'
Soccer 1 and 2	30fc	2:1	84	30.0' x 30.0'

- B. Color Temperature: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.
- C. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare onfield and providing sufficient uplight.
 - 1. Aiming Angles: To reduce glare, luminaire aiming should ensure the top of the luminaire field angle (based on sample photometric reports) is a minimum of 10 degrees below horizontal.
 - 2. Glare Control Technology – Luminaires selected should have glare control technology including, but not limited to: external visors, internal shields and louvres. No symmetrical beam patterns are acceptable.
 - 3. Aerial lighting – Adequate illumination must be provided above the field in order to see the ball in flight. It is recommended that a lighting analysis be performed above the field of play to evaluate the visibility of the ball over its typical trajectory to ensure the participants will adequately see the ball. Calculation planes should be evaluated up to the maximum anticipated height for the level of play.
 - 4. Mounting Heights: To ensure proper aiming angles, minimum mountings heights shall be as described below. Higher mounting heights may be necessary for luminaire with lesser glare control to meet field angle requirements of section 1.2.C.1.

# of Poles	Pole Designation	Pole Height
Seven (7)	A3, A4, A7, A8, A9, C3, C4	60'
Five (5)	A1, A2, A5, A6, B5	70'
Six (6)	B1, B2, B3, B4, C1, C2	100'

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1.3 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.
- B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet or 5 feet (cd) above grade at 30-foot intervals.

Residential Property Spill (spill/glare values at adjacent residential properties)	Average	Maximum
Max Horizontal Spill Light (all zones) at adjacent residential properties	0.25 fc	2.0 fc
Max Vertical Spill Light (all zones) at adjacent residential properties	0.5 fc	2.0 fc
Max Candela (per fixture, all zones) at adjacent residential properties	2,000 cd	8,000 cd

Glare to Batters and Outfielders	Average	Maximum
Max Candela (per fixture from outfield poles) to any baseball or softball batter	950 cd	1,000 cd
Max Candela (per fixture, all zones) to any baseball or softball outfielder	750 cd	4,500 cd

Property Line Spill	Average	Maximum
Max Horizontal Spill Light (all zones) at any point along property line	1.25 fc	7.5 fc
Max Vertical Spill Light (all zones) at any point along property line	1.5 fc	8.5 fc
Max Candela (per fixture, all zones) at any point along property line	10,000 cd	70,000 cd

- C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal footcandles, maximum vertical footcandles, and candela values 150' from field boundary, nearest residential property lines (south and east), and nearest residential properties (south and east) as defined. Calculations shall be shown at 30-foot intervals along 150' boundary from edge of field(s) and other critical spill lines as defined.
- D. Glare analysis to baseball and softball batters from outfield poles, and outfielders from infield poles, must also be provided. For Baseball 1 and 2 with home plate as 0',0', assume the following outfield positions for LF (263', 46'), for CF (204', 204'), and for RF (263', 46'). For Softball 3 with home plate as 0',0', assume the following outfield positions for LF (177', 31'), for CF (127', 127'), and for RF (177', 31'). For Softball 4 and 5 with home plate as 0',0', assume the following outfield positions for LF (163', 29'), for CF (124', 124'), and for RF (163', 29').

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- E. Sample Photometry: The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years experience or by a manufacturer’s laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.
- F. Field Verification: Lighting manufacturer shall supply field verification of environmental light control using a meter calibrated within the last 12 months:
 - 1. Spill verification: Illumination levels shall be taken in accordance with IESNA RP-6-22. The light sensing surface of the light meter should be held 36 inches above the playing surface with the sensing surface horizontal (for horizontal readings) or vertically pointed at the brightest light bank (for max vertical readings).
 - 2. Glare verification: The light sensing surface of the luminous intensity meter should be held 60 inches above grade with the aperture adjusted so that it detects luminous intensity from the brightest luminaire on each light bank.

1.4 COST OF OWNERSHIP

- A. Manufacturer shall submit a 25 year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

PART 2 - PRODUCTS

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.
- C. System Description: Lighting system shall consist of the following:
 - 1. Galvanized steel poles and cross-arm assembly.

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2. Non-approved pole technology:
 - a. Square static cast concrete poles will not be accepted.
 - b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
3. Lighting systems shall use concrete foundations. See Section 2.4 for details.
 - a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
 - b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-inforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
4. Manufacturer will supply all drivers and supporting electrical equipment
 - a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed.
 - b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.
7. Control cabinet to provide remote on-off control, monitoring of the lighting system. See Section 2.3 for further details.
8. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
 - a. Integrated grounding via concrete encased electrode grounding system.

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- b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

D. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

- 1. Electric power: 480 Volt, 3 Phase
- 2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 138.34 kW.

2.3 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Contactor control of lights: To minimize wear on drivers and other electrical components and prevent lights from turning on due to communication loss, circuits must be controlled via contactor switching, not dimming driver output to zero.

D. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, fax, email)

E. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

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- F. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).
- G. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.
 - 1. Cumulative hours: shall be tracked to show the total hours used by the facility
 - 2. Report hours saved by using early off and push buttons by users.
- H. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.
- I. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

2.4 STRUCTURAL PARAMETERS

- A. Wind Loads: Wind loads shall be based on the 2018 International Building Code. Wind loads to be calculated using ASCE 7-16, an ultimate design wind speed of 110 mph and exposure category C.
- B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).
- C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report.
- D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 - EXECUTION

3.1 SOIL QUALITY CONTROL

- A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:
 - 1. Providing engineered foundation embedment design by a registered engineer in the State of New York for soils other than specified soil conditions;
 - 2. Additional materials required to achieve alternate foundation;

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3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY TIMING

- B. Delivery Timing Equipment On-Site: The equipment must be on-site 10-12 weeks from receipt of approved submittals and receipt of complete order information.

3.3 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-22.
- B. Field Light Level Accountability
 1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.
 2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
 3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities, including off-site spill and glare. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, and upright for aerial visibility are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer will be required to make adjustments needed to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

- A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

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- B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

END OF SECTION 265668

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SECTION 311201 - SITE PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The general provisions of the Contract, including General and Supplementary Conditions and General Requirements (if any), apply to the work specified in Division 31, 32 and 33.

1.2 DESCRIPTION OF WORK

- A. The extent of site preparation is shown on the drawings.
- B. Site preparation work includes, but is not limited to, the following:
 - 1. Site investigation and underground utility identification
 - 2. Protection of existing trees, shrubs, ground covers and lawns to remain
 - 3. Topsoil stripping and stockpiling on site (See Section 329201)
 - 4. Site clearing and removals
 - 5. Temporary construction roads and staging areas
 - 6. Temporary construction fences and gates
 - 7. Saw cutting
 - 8. Relocations/salvaged materials
 - 9. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 015000 - Temporary Facilities and Controls
- B. Section 312201 - Site Earthwork
- C. Section 329201 - Lawns
- D. Section 334001 - Storm Drainage

1.4 SITE INVESTIGATION

- A. The Contractor shall visit the site before bidding, inform and familiarize themselves of all site conditions, including but not limited to, site topsoil, sub-soil, rock, subsurface and groundwater conditions affecting proposed work. No allowance or additional cost will be made in the work of this contract for failing to determine overall project site conditions.
- B. Verify locations and protect utilities and structures, whether or not shown on the drawings. Existing utilities and structures shown on the drawings are for the Contractor's convenience and locations are not guaranteed.
- C. Verify survey information given on drawings. Walk the site with the Owner's Facilities Management Personnel to discuss approximate locations of reputed utilities not

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shown on the survey, prior to performing work. Notify the Architect of any and all discrepancies prior to commencing work. Commencement of work will be construed as complete acceptance of survey information.

- D. Locate and protect from disturbance existing survey monuments, pins, markers and benchmarks whether or not shown on drawings. When any disturbance or damage occurs, notify Architect in writing within 24 hours. Describe nature of disturbance or damage and date first occurred. Provide copies to applicable government and municipal agencies. Pay costs for restoring monument to satisfaction of said agencies, at no additional expense to the Owner.

1.5 JOB CONDITIONS

- A. The terms "Architect" and "Landscape Architect" for Divisions 31, 32 and 33 work shall mean Appel Osborne Landscape Architecture, Syracuse, NY 13204, Tel. (315) 476-1022.
- B. Examine drawings and specifications for the entire project. Become familiar with the scope and sequencing of work required. Coordinate and cooperate with other Contractors and trades working in and adjacent to the project.
- C. Examine work prepared prior to this contract. Commencement of work will be construed as complete acceptance of all preparatory work by others.
- D. Obtain and pay for permits required by authorities. Perform the work in compliance with applicable standards, codes and requirements of governing authorities having jurisdiction.
- E. Safety is the sole responsibility of the Contractor.
- F. Burning on site and use of explosives are not permitted.
- G. Responsibility for existing utilities:
 - 1. Contact Dig Safely New York at least two (2) full working days, and not more than ten (10) working days, before digging begins or as required by latest state law. Locate by hand excavation and provide protection from damage to existing utilities to remain in the area. (Tel. 811)
 - 2. Existing utilities encountered within excavated areas shall be supported, blocked and/or braced in a manner approved by the owner of the utility. Leave supports in place to the extent required by the owner of the utility.
 - 3. Should uncharted or incorrectly charted utilities be encountered, notify the Architect immediately for directions as to procedure.
 - 4. Do not break utility connections without providing temporary services as acceptable to the Architect and the owner of the utility.
 - 5. Repair and pay for damages to existing utilities as directed by utility Owner at no additional cost to the Owner.

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6. Cap ends of utilities to be abandoned or removed in accordance with regulatory agencies and as directed by the Architect.
- H. Provide protections and conduct operations to prevent injury and damage to persons, work of other Contractors, existing items to remain, structures, pavements, lawns, and adjacent properties.
- I. Restore work damaged by this Contractor inside and outside the contract limits to the condition existing prior to the start of work, unless otherwise directed, to the satisfaction of the Architect at no additional cost to the Owner.
- J. Vehicular and pedestrian traffic control:
 1. Maintain vehicular and pedestrian traffic during construction activities.
 2. Provide alternate routes and traffic control around closed and obstructed traffic ways as required by governing regulations or the Owner.
 3. Provide temporary fencing, flagpersons, barricades, warning signs, and warning lights or other measures to protect the public and cause the least interruption of work.
- K. Field Measurements: Take necessary field horizontal and vertical measurements required in order to perform the work and design intent shown on the drawings, and outlined in the specifications. Assume complete responsibility for accuracy of such measurements and dimensions.
- L. Removal of spoils, dust control, debris, snow and clean up:
 1. Control air pollution caused by dust and dirt; comply with governing regulations. Water to control dust when necessary and as directed by the Architect or Certified Erosion Control Specialist. Provide water sprinkling materials, equipment and labor to prevent the nuisance of dust to the surrounding areas.
 2. Legally dispose of removed and demolished items, including trash and debris, off the Owner's property, at a licensed disposal facility having adequate capacity to accept the project's waste.
 3. Burning of combustible materials on the site is not permitted.
 4. During the contract and at intervals as directed by the Architect, clear the site of extraneous materials, rubbish, construction waste, and debris. Leave the site in a clean, safe, neat, well-draining condition.
 5. Soil and Snow Removal: Sweep roads, access ways, paved areas, and parking areas where soil, mud and debris have dropped or tracked from construction and delivery vehicles on a daily basis and as directed by the Architect or Certified Erosion Control Specialist. Remove snow and ice from roads, access ways, paved areas and parking areas utilized for site construction purposes.

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6. Spoils: Remove from site and dispose when not required for fill or determined to be unsatisfactory soil material per Section 312201 - Site Earthwork.
- M. Construction Review - General: Site visits will be made by the Architect to observe construction conformance to drawings and specifications. The occasional site visits by the Architect shall not be construed as supervision of construction or make them responsible for the safety programs and precautions, including but not limited to: the safe access, visit, use, work travel, or occupancy of any person. Site visits shall not make the Architect responsible for means, methods, techniques, sequences or procedures of construction selected by the Construction Manager, Contractor or his Sub-contractors.
- N. Site Complexity: The existing site will be intensively developed. Because of the construction and resulting graphic complexity, it is impractical to show every detail. However, the general design intent is clearly shown and shall be applied to individual conditions not specifically shown as directed by the Architect and at no additional cost to the Owner.
- O. Asbestos, Toxic and Hazardous Materials: The Division 31, 32 and 33 site work contract does not include testing for, handling or removal of hazardous materials such as, but not limited to: asbestos, fuel, oil, PCB's, or other toxic or hazardous waste materials as identified by the EPA and/or NYSDEC. If any such materials are encountered during any part of the site work, the Contractor is responsible for identifying potential hazardous material and immediately notify all governing agencies having jurisdiction as required by law. Also, within one (1) hour of discovery notify the Architect, Landscape Architect, Consultants, and Owner. The Owner shall provide testing and removal by others, under separate contract. The Contractor shall recommence work under this contract when the Owner provides written certification that remediation is complete per governing agency. The Contractor shall not be penalized for any delays caused by the hazardous testing and removal, unless such hazardous material incident was a result of Contractor's operations. The Contractor shall indemnify and hold harmless the Architect, Landscape Architect, Consultants and Owner, agents, and employees from and against all claims, damages, losses and expenses, direct and indirect or consequential damages, including but not limited to fees and charges of attorneys and court and arbitration costs, arising out of or resulting from the performance of the work by the Architect, Landscape Architect, Consultants and Owner, or claims against the Architect, Landscape Architect, Consultants and Owner arising from the work of others, related to hazardous waste.

The above indemnification provision extends to claims against the Architect, Landscape Architect, Consultants and Owner which arise out of, are related to, or are based upon, the dispersal, discharge, escape, release or saturation of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, or pollutant in or into the atmosphere, or on, onto, upon, in or into the surface or subsurface soil, water or water courses, objects, or any tangible or intangible matter, whether sudden or not.

Should the hazardous material incident be the result of the Contractor's operations, the Contractor shall be responsible for all costs associated with the discovery and remediation of such hazardous material such as, but not limited to: testing, consultant fees, damage, loss, fees and charges of attorneys, court and arbitration costs, claims by other contractors, direct and indirect or consequential damages.

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- P. Salvageable Items: Remove at any time after work starts. Storage or sale on site of salvageable and removed items is not permitted. Do not remove topsoil from site without written permission from the Owner.

1.6 SUBMITTALS:

- A. Provide photographic documentation. Photographically document existing features which, may be affected by the construction, inside and outside the contract limit line. Existing features include, but are not limited to: structures, pavements, curbs, utilities, lawns and vegetation, especially individual trees which are over six (6") inches in diameter and noted to remain on the drawings. Also, particular attention shall be paid to the construction access, stockpile and haul road areas. Distribute a copy of the photographic documentation to the Owner and Architect prior to the start of construction.
- B. Provide material certificate showing content/mechanical analysis for staging area/construction road stone.
- C. Temporary Chain Link Fence and Gates Manufacturer's Product Data (MPD).

PART 2 - PRODUCTS

2.1 TEMPORARY CHAIN LINK FENCE AND GATES

- A. Shall be new or good quality 6'-0" height galvanized chain link fence and gates.
- B. Materials and layout shall be as detailed on the drawings and as directed by the Owner.

2.2 PLASTIC FENCE

- A. Shall be new or good quality used 4'-0" high heavy duty orange plastic fence NC450.
- B. Posts shall be new or good quality U-channel posts to hold plastic fence.

2.3 OTHER PROTECTIVE DEVICES

- A. Shall include, but not be limited to; wood planks, rubber mats, barriers, lights, barricades, coverings, traffic controls, steel plates, and other temporary protections.
- B. Contractor to provide all necessary protections required by Occupational Safety and Health Administration (OSHA).

2.4 STAGING AREA/CONSTRUCTION ROADS

- A. Staging Area/Construction Road Stone: Shall be run of crusher limestone meeting the following gradation as determined by ASTM-C136:

<u>Standard Sieve Size</u>	<u>Percent Passing By Weight</u>
2" or 50 mm	100%
3/4" or 19 mm	75 - 90%

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1/4" or 6.3 mm	30 - 65%
#40 or 425 mm	5 - 40%
#200 or 75 mm	0 - 8%

- B. Soil Stabilization Fabric: Shall be a commercially manufactured, UV stabilized low clogging, high flow, woven geotextile. Standard of quality shall be Mirafi 500X, as manufactured by NICOLON/MIRAFI GROUP, 3500 Parkway Lane, Norcross, Georgia (Tel. 1-800-234-0484) or Architect approved equal.

PART 3 - EXECUTION

3.1 PROTECT EXISTING VEGETATION TO REMAIN

- A. Prior to commencing site preparation work, notify Architect, and meet on site to locate existing trees, lawns and vegetation which are to remain.
- B. Protect and keep existing vegetation to remain free from physical damage. Keep in a healthy, vigorous growing condition for the entire construction period as follows:
1. Keep site disturbance and staging limits to a minimum. Obtain approval from Owner for material and equipment storage areas. Limit access points and routes to the project site. Coordinate site access with other trades and contractors on the work site.
 2. Groups of Trees and Vegetation: Place orange plastic construction fencing around drip line(s) of trees and plant beds as detailed or directed by the Architect. Do not store materials, run equipment, park vehicles, or otherwise disturb area within the drip line (full canopy of tree) or in plant beds.
 3. Specimen and Individual Trees: Protect each as noted and detailed. Do not store materials, run equipment, park vehicles or otherwise disturb area within the drip line (full canopy of tree).
- C. Rejuvenate damaged vegetation by pruning watering, fertilizing, staking and other methods as directed by the Architect. Replace trees and other vegetation that cannot be restored to full growth with comparable size, quantity, quality and species as determined by the Architect.
- D. Repair lawns disturbed due to construction operations outside the grading limits, as specified and directed by the Architect. Provide screened topsoil, seed, and mulch over damaged lawn areas, access ways or where tire rutting occurred.

3.2 TOPSOIL STRIPPING AND STOCKPILING ON SITE

- A. Strip full depth of existing topsoil from areas to be regraded, paved, or otherwise built upon. When amount of available topsoil exceeds what is indicated in geo-tech/boring report, on site test pits, or Contractor assumed depth, continue to remove all topsoil and lower the paved or built element subgrade. Place additional satisfactory earth fill in uniform depths as indicated in the Site Earthwork Section 312201. Maintain finished grades as shown on the drawings. This work shall be done at no additional cost to the Owner.

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- B. Minimum quantity of topsoil shall be as needed to provide four (4") or six (6") inches settled depth on lawn areas. Verify quality and quantity. Supply imported topsoil when amount of available topsoil meeting above requirements is less than what is required for the proposed lawn areas. See Section 329201 for imported topsoil requirements.
- C. When amount of available topsoil meeting above requirements exceeds what is required for the proposed lawn and athletic field areas, lower the lawn and athletic field subgrade and place additional topsoil in a uniform depth as directed by the Architect. Maintain finish grades as shown on the drawings. This work shall be performed and supplied at no additional cost to the Owner.
- D. Topsoil shall be well drained, homogeneous texture soil of uniform grade, without the admixture of subsoil material. Topsoil shall be free of dense material, hardpan, and stone over three-quarters (3/4") inch in diameter, and other objectionable foreign material including, but not limited to, brick, concrete, asphalt, glass, nails, screws, toxins, hazardous wastes and chemicals (such as, but not limited to, atrazine and muriatic acid) that may be injurious to humans, animals and plant materials.
- E. Stockpile on site where shown on the drawings or as directed by the Owner. Provide all hauling as necessary. Do not mix topsoil stockpiles with other materials.
- F. Contractor shall remove, load, haul, and stabilize two hundred (200) cubic yards of striped topsoil to the Owner's stockpile location, Town of DeWitt DPW, 5953 Butternut Drive, East Syracuse, NY. Coordinate with DPW Highway Superintendent, Rocco Conte (315)-437-8331. Stabilize and maintain all stockpiles as specified. Excess topsoil, not needed for proposed lawns, as specified, shall be removed, loaded, hauled, and stabilized offsite by the Contractor at no additional cost to the Owner.

3.3 SITE CLEARING AND REMOVALS

- A. Items and materials noted to be removed shall become the property of the Contractor, unless otherwise noted. Obtain Owner's approval prior to removal off site or for relocation of salvaged material on site. Remove material off site and legally dispose of it. Backfill voids with imported granular backfill, placed in eight (8") inch layers compacted to 95% maximum density.
- B. Remove physical elements above and below grade as shown and which interfere with proposed construction. Physical elements include but are not limited to: trees, root systems, shrubs, vines, grass, vegetation, pavements, walks, curbs, gutters, foundations, previous construction materials, glass, headwalls, flared end sections, catch basins, manholes, inlets, drywells, septic tanks, unused utilities, pipes, cisterns, walls, rocks, and other debris.
- C. Trees, shrubs and roots shall be completely removed, chipped into two (2") inch and smaller pieces and hauled to the Town of DeWitt, 5953 Butternut Drive, East Syracuse, NY 13057, contact: Rocco Conte, Highway Superintendent, (315) 437-8331. Notify owner 48 hours prior to delivery.

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- D. Maintain existing utilities shown to remain and protect from damage during demolition and construction operations. Do not interrupt existing utilities; provide temporary services when required, as acceptable to the Architect.
- E. Research with Owner possible locations of existing subsurface utilities prior to excavating.

3.4 TEMPORARY CONSTRUCTION ROADS AND STAGING AREAS

- A. Install soil stabilization fabric as specified and overlap fabric two (2') feet minimum. Provide 95% compacted staging area/construction road stone for temporary construction roads and staging areas as shown on the drawings and as required by the Contractor to access the proposed work.
- B. Near the project completion, remove the stone staging area/construction roads and soil stabilization fabric. Recondition and decompact existing topsoil, fine grade, and seed as directed by the Architect to match existing lawn conditions.
- C. Near the project completion, repair asphalt and concrete to match existing conditions, power wash area, seal coat asphalt, and repaint parking lines as directed by the Architect.

3.5 SAW CUTTING

- A. The Work consists of vertical saw cutting of the existing asphalt or concrete pavement structure to facilitate the removal of the asphalt or concrete bound material.
- B. The equipment shall be capable of producing a smooth vertical saw cut without causing damage to the adjacent pavements or related site features.
- C. The Contractor shall saw cut the asphalt/concrete pavement to a depth which will allow removal of the material without causing damage to the adjacent pavement. Rough, jagged or cracked edges will not be acceptable. Concrete pavement shall be removed at the nearest contraction joint.

3.6 RELOCATIONS

- A. Any item noted to be relocated shall be removed by the Contractor from its existing position without damaging it, stored, protected from theft, fire, vandalism and damage for the project duration. Reset in the location(s) and in the manner detailed, noted on the drawings or specified.
- B. Backfill voids with imported granular fill material, placed in eight (8") inch layers compacted to 95% maximum density when located in proposed pavement areas or 90% maximum density when located in proposed non-paved areas.
- C. Salvaged items shall be returned to the Owner as noted on the drawings. Move items to Owner designated areas.

3.7 CLEAN UP

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During the contract and at intervals as directed by the Architect and as site preparation is completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 311201

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SECTION 312201 - SITE EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of site earthwork and site grading is shown on the drawings.
- B. Site earthwork includes, but is not limited to, the following:
 - 1. Fill Materials
 - 2. Source Quality Control
 - 3. Shoring, Bracing, and Supporting
 - 4. Horizontal and Vertical Layout
 - 5. Grading and Excavation
 - 6. Compacted Backfill and Fill
 - 7. Stone Blanket(s)
 - 8. Field Quality Control Testing and Inspection Services
 - 9. Guarantee
 - 10. Clean Up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 023200 - Subsurface Investigation Information
- B. Section 311201 - Site Preparation
- C. Section 312300 – Structural Excavation, Backfill, and Compaction
- D. Section 312501 - Erosion, Sediment, and Pollution Control
- E. Section 334001 - Storm Drainage

1.3 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials
- B. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D 75 - Practice for Sampling Aggregates
- D. ASTM D 422 - Particle-Size Analysis of Soils (without Hydrometer Analysis)
- E. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)

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- F. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
- G. ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
- H. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- I. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- J. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- K. ASTM D 6938 - In Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
- L. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- M. ASTM D 5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
- N. Deep Ripping and Decompaction shall be per NYSDEC recommendations, latest edition
- O. Occupational Health and Safety Administration Regulations and Standards
- P. American Sports Builders Association (ASBA): Sports Fields - A Construction and Maintenance Manual, latest edition.
- Q. EN 12616 – Permeability of Synthetic Turf Sports Field Base Stone by Double Ring Infiltrometer, Method A.
- L. Occupational Health and Safety Act.

1.4 SUBMITTALS

- A. Furnish name of New York State licensed Land Surveyor to be employed and perform project layout. Obtain Architect's approval prior to performing work.
- B. Submit written report on NYS licensed Land Surveyor's letterhead verifying that professional's involvement with the project layout. The report shall briefly state the scope of services performed for the project, the dates work was accomplished and an explanation of any adjustments required, specifically listing as-built and FIELD VERIFY requirements as noted in 3.2 of this specification section.
- C. Provide Earthwork Contractor's experience requirements as indicated in 1.5, "Quality Assurance". Obtain Architect's approval prior to performing work.

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- D. Samples: 10 lb. samples of each type of fill; submit in airtight containers to testing laboratory.
- E. Materials Sources: Submit name of imported materials source for each type of fill material.
- F. Fill Composition Test Reports (Imported and Onsite): Provide results of laboratory tests (less than 2 months old) on proposed and actual materials used to determine acceptability. This shall include:
 - 1. One optimum moisture-maximum density curve (Modified Proctor) for each soil/imported fill type as determined by ASTM D1557, Method A, latest issue.
 - 2. Sieve Analysis - ASTM D422
 - 3. Moisture Density Relationship - ASTM D1557, Method C / ASTM D698
 - 4. Plasticity Index - ASTM D4318
 - 5. Soundness Test - ASTM C88
 - 6. Soil Classification - AASHTO and ASTM D2487
- G. Compaction Density Test Report(s) required in Field Quality Control of this specification.
- H. Contractor's NYS Licensed Professional Engineer's layout and design calculations of sheet piling and shoring required.
- I. Synthetic Turf Permeability Testing: Engage an independent testing agency to perform ten (10) permeability test of both the finishing stone and base stone of proposed synthetic turf stone blanket as determined by ASTM D2434, ASTM F2898-11, and EN 12616. Results shall meet the following at minimum:
 - 1. permeability of base stone > 40"/hour
 - 2. permeability for finishing stone > 40"/hour

1.5 QUALITY ASSURANCE

- A. Perform all site earthwork, site grading and excavation in compliance with requirements of governing authorities having jurisdiction, OSHA Standards, and "References" in this project specification.
- B. The Owner will employ a licensed soil testing and inspection service for Field Quality Control Testing of materials. This Contractor will coordinate day to day scheduling with the Owner's testing agency for conformance with "Field Quality Control Testing and Inspection Services" in this project specification.
- C. Earthwork Contractor Experience Requirements: Submit business name, business Owner(s) name(s), business address, telephone number, website and/or email address signed by the Contractor/Subcontractor who meets the qualifications set forth in this specification and is proposed by the Contractor to perform the Earthwork for this Project. Provide a list of at least four (4) Earthwork projects of comparable size, scope and quality completed successfully by the proposed Contractor/Subcontractor within the past four (4)

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years that includes the date completed, project Owner's name and current contact information, including telephone numbers and email addresses.

- D. Layout Foreman Experience: The Earthwork Contractor must provide a competent layout foreman skilled in this specific type of layout/earthwork project. The layout/earthwork foreman shall have a minimum of four (4) similar projects completed within the last four (4) years. Provide a list of projects layout/earthwork foremen has completed including project name, address, Owner contact information and project scope of work.

1.6 JOB CONDITIONS

- A. Job conditions in Section 311201 apply.
- B. Provide sufficient quantities of fill materials to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- C. When fill materials need to be stored on site, locate stockpiles where directed by Owner.
1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 2. Prevent contamination of material types.
 3. Protect all stockpiles from erosion and deterioration of materials by covering with plastic sheets, tarps or as directed by the Architect.
- D. Moisten or dry, fill or backfill materials, to the proper moisture content as determined in accordance with ASTM D1557, Method C in order to obtain proper compaction as indicated.

1.7 SUB-SURFACE SOIL INFORMATION

- A. Refer to subsurface information elsewhere in the specifications. The geo-technical data on subsurface conditions is not intended as representation warranties of the continuity of such conditions between test pits or test borings made by the Owner and included in the specification. It is expressly understood that the Owner, Architect, Landscape Architect, and Consulting Engineers are not responsible for interpretations or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor.

1.8 UNUSUAL SUBSURFACE CONDITIONS

Notify the Architect immediately in writing via email when unusual conditions are encountered during excavation, including, but not limited to: excessive flooding, miscellaneous structures, uncharted or unlocated utilities, foundations, bed rock, toxic and hazardous materials and chemicals (such as muriatic acid and atrizene), suspected archaeological artifacts, and unsatisfactory soil materials. Request clarification before proceeding. Refer to paragraph 3.4 of this specification Section.

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PART 2 -PRODUCTS

2.1 FILL MATERIALS

A. Satisfactory General Earth Fill:

1. To be used outside of structural elements.
2. Satisfactory earth fill shall be satisfactory on-site subsoil or hauled in off-site subsoil free of toxics, hazardous wastes and chemicals (such as, but not limited to, atrizene and muriatic acid) that may be injurious to humans, animals and plant materials. Satisfactory earth fill shall also be free of rubbish, debris, wood, masonry, metal, frost, vegetation or other deleterious material, which cannot be properly compacted. Use general earth backfill that is dry and free of clay. Rocks, gravel or earth shall not be larger than 3" in any dimension/direction.
3. Satisfactory earth fill materials are also defined as those complying with the American Association of State Highway Transportation Officials (AASHTO), M-145 soil classification Groups A-1, A-2-4, A-2-5, A-3 and Unified Soil Classification System GW, GP, GM, GC, SW, SP, SM, and SC as determined by ASTM D2487.

B. Imported Granular Backfill:

1. Imported granular backfill to be used for asphalt pavement subbase, concrete subbase, storm structures, storm pipes, sanitary manholes, sanitary pipes, and other structures.
2. Backfill shall be run of crusher limestone meeting the following gradation as determined by ASTM-C136:

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
2" or 50 mm	100%
3/4" or 19 mm	75 - 90%
1/4" or 6.3 mm	25 - 60%
#40 or 0.425 mm	5 - 40%
#200 or 0.075 mm	0 - 8%

3. Backfill shall be free of debris and deleterious materials. In no case shall the plasticity index exceed 5.0 or the percentage passing the 200 mesh sieve exceed 8%. The quality of the imported granular backfill shall be determined by the magnesium sulfate soundness test, if considered suspect by the Architect. The maximum percent loss at four cycles by weight shall be 20.

C. Imported Structural Fill:

1. Imported structural fill to be used for top eight (8") inches of design subgrade elevation for turf field concrete edge, and where noted on the drawings.

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2. Shall be run-of-bank gravel free from organic matter or other deleterious materials, meeting the material gradation requirements of Item 304.05 Sub-base Course, Type 4, of the NYSDOT's Standard Specifications for Construction Materials, as determined by ASTM C136.

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
2" or 50 mm	100%
1/4" or 6.3 mm	30 - 65%
#40 or 0.425 mm	5 - 40%
#200 or 0.075 mm	0 - 8%

D. Drywell and Stormwater Management Trench (SMT) Backfill:

1. Shall be No. 1 clean, washed, crushed stone meeting the following gradation as determined by ASTM C136:

<u>Standard Sieve Size</u>	<u>Percent Passing By Weight</u>
1" or 25.0 mm	100%
1/2" or 12.5 mm	90-100%
1/4" or 6.3 mm	0-15%

E. Vertical Drain Backfill:

1. Shall be clean, coarse concrete sand, meeting the following gradation as determined by ASTM C136:

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
3/8" or 9.5 mm	100%
#4 or 4.75 mm	75 - 90%
#16 or 1.18 mm	30 - 45%
#50 or 0.3 mm	5 - 10%
#100 or 0.15 mm	2 - 5%

F. Water line Backfill:

1. Shall be clean, coarse concrete sand, meeting the following gradation as determined by ASTM C136:

<u>Standard Sieve Sizes</u>	<u>Percent Passing By Weight</u>
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3/8" or 9.5 mm	100%
#4 or 4.75 mm	75 - 90%
#16 or 1.18 mm	30 - 45%
#50 or 0.3 mm	5 - 10%
#100 or 0.15 mm	2 - 5%

G. Stone Blanket (For Synthetic Turf):

1. Material shall be a 100% fractured, by mechanical means, with elongated characters on each individual particle larger than 1/4". Material shall be clean of mineral fines with particles smaller than 1/4" by manufactured means. Rounded sands are prohibited.

Typical aggregate blends found acceptable as a stone blanket course conform to the following gradation as determined by ASTM C136:

<u>Standard Sieve Sizes</u>	<u>Base Stone Percent Passing by Weight</u>	<u>1/2" Max. Depth Finishing Stone Percent Passing by Weight</u>
1-1/2" or 38.0 mm	100	-
1" or 25.0 mm	95 - 100	-
3/4" or 19.0 mm	80 - 100	-
1/2" or 12.5 mm	60 - 80	100
3/8" or 9.5 mm	30 - 50	95 - 100
No. 4 or 4.75 mm	20 - 40	70 - 85
No. 8 or 2.36 mm	10 - 30	45 - 60
No. 16 or 1.18 mm	2 - 25	25 - 40
No. 40 or 0.425 mm	5 - 17	2 - 12
No. 200 or 0.075 mm	0 - 4	0 - 3

2. Delivery Moisture Content: Processed stone must contain 90% to 110% of the optimum moisture content to ensure that fines do not migrate and to facilitate proper compaction. The Contractor shall ensure aggregate leaving the source plant meets this requirement and shall be required to apply water to the processed stone on site if necessary to achieve the minimum moisture content.
3. Soil Separation Fabric: Shall commercially manufactured non-woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by TENCATE or Architect approved equal.
4. Mechanical analysis of base and finishing stone shall be reviewed and approved by both the Architect and turf manufacturer.

2.2 UNSATISFACTORY SOIL MATERIALS

- A. Shall be defined as soil with high percentage of decomposed rock, sand, organic matter or moisture laden clay to prevent adequate compaction. Also, soil with toxics, hazardous wastes and chemicals (such as atrazine and muriatic acid) that may be injurious to humans, animals and plant materials. Also, soil with significant quantities of rubbish,

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debris, wood, masonry, metal, frost or other deleterious material which cannot be properly compacted shall be classified as unsatisfactory.

- B. Unsatisfactory soil materials are defined as those described in AASHTO M-145, soil classification, Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 with CBR value less than 7.0. Also Unified Soil Classification System ML, CL, OL, MH, CH, OH as determined by ASTM D2487 with CBR value less than 7.0 in addition to peat and other highly organic soils; and soil materials of any classifications that have a moisture content at the time of compaction beyond the range of 1% below and 3% above the optimum moisture content of the soil material/backfill material, as determined by the Moisture Density Relationship test.
- C. When unsatisfactory soil materials are encountered at proposed subgrades and other design elevations, proceed as described in Part 3 (Execution) of this Section.
- D. The use of slag (a byproduct of metal processing) is unacceptable for any use on this project site.

2.3 SOURCE QUALITY CONTROL

- A. See "Quality Assurance" of this specification section for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, Contractor is responsible to test and analyze all samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.

2.4 SHORING, BRACING AND SUPPORTING

- A. Shoring and bracing shall conform to the requirements of the Occupational Health and Safety Act.
- B. Shoring and bracing shall be provided, placed and maintained at the locations and elevation that are necessary or required to: support and protect the sides and bottom of the excavation; prevent undue disturbance or weakening of the supporting materials below or beside the works; prevent movement of ground which may disturb or damage the work, adjacent pavements, property, structures or other works.
- C. Provide materials for shoring, bracing and supporting, such as sheet piling, uprights, sheathing, stringers and cross-braces, in good serviceable condition. Use timbers that are sound and free of large or loose knots.
- D. Provide design by Contractor's NYS Licensed Engineer, when shoring is required to perform work as shown on the drawings. Submit to Architect for approval.
- E. Installation: Shoring and bracing shall be driven and placed so that it can be removed as backfilling takes place without damage to the pipeline or its appurtenances, structures, and without settlement of or damage to adjacent pavements and structures.

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- F. Removal: The Contractor shall remove all shoring and bracing as the excavation is backfilled, unless directed by the Architect to be left in place. The procedure for extracting shoring and bracing and placing backfill shall ensure the backfill load is applied gradually and disturbance of the works or foundation material is avoided.
- G. Support all utilities as required by the municipality/utility owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field conditions such as bench marks, monuments, topography, inverts, locations of utilities and property lines before proceeding. Notify the Architect immediately, in writing, of discrepancies prior to commencing work. Commencement of work will be construed as complete acceptance of survey and layout information. Additional costs resulting from failure to verify field conditions prior to commencing work shall be borne by this Contractor and at no additional cost to the Owner.

3.2 LAYOUT

- A. Stake layout up to and including those elevations and dimensions specifically noted on drawings as "FIELD VERIFY" (FV). Ensure that the field elevation and dimension agrees with the elevation and dimension on the drawings before continuing. Notify the Architect immediately, in writing, of any discrepancies prior to commencing work. Additional costs resulting from failure to verify dimensions as noted on drawings shall be borne by this Contractor and at no additional cost to the Owner.
 - 1. Assume sole responsibility for the accuracy of the layout work.
 - 2. Run from point(s) of beginning (POB), base lines, property monuments, bench marks, iron survey pins, or other points given on the drawings.
 - 3. Roads, Parking Areas, and Walks: Accurately locate and stake curblines, center line, swales, point of curve and tangency as necessary to accurately build.
 - 4. Buildings and Site Features: Accurately locate and stake corners, offset corners, slopes, and center lines as necessary to accurately build.
 - 5. Pipe Work: Accurately locate with laser.
- B. Athletic Field Layout:
 - 1. Provide accurate layout, alignment and dimensions for fields as shown on drawings and detailed by professional NYS Land Surveyor approved by the Architect.
 - 2. Temporarily stripe lawn athletic fields with field line marking mixture approved by Owner and correct surface high and low spots as described in Section 329201 prior to seeding or sodding.

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3. Temporarily stripe synthetic turf stone blanket subgrade with field line marking mixture approved by Architect. Meet tolerances described in 3.3 of this specification Section. Correct differences as directed by the Architect.
4. Temporarily stripe synthetic turf stone blanket surface every five (5) yards across the field with field line marking mixture approved by Architect. Correct surface high and low spots as described in Section 334001 prior to synthetic turf installation.

3.3 GRADING

- A. Cut and Fill: Presume the earthwork does **NOT** balance on site. Meet the grades shown on the drawings. Haul in or haul away as may be necessary. Provide earthwork calculations, and provide for imported or exported material as part of bid. No additional costs will be allowed.
- B. Grade areas as indicated, including transition areas, with uniform levels and slopes between finish elevations.
- C. Cut to grades and profiles indicated.
- D. Set grade stakes at fifty foot (50') intervals, at corners, and breaks in grade.
- E. Conduct operations to avoid ponding of water. Provide all pumping equipment, sump pits, and temporary diversion swales where and when necessary to continue work performance on schedule and as specified.
- F. Shape subgrade surface of site elements to within 0.10' above or below required subgrade elevation, compacted as required and sloped to provide drainage as shown on the drawings. Notify Architect and Geo-Technical Engineer for subgrade review prior to continuing work.
- G. Shape subgrade surface of athletic fields and track/tennis courts areas using laser plane control system for grading of subgrade elevation to ensure accuracy in grade tolerances of +0" to - 1/4" in 10' any direction. Compact as required and sloped to provide drainage as shown on the drawings. Notify Architect and Geo-Technical Engineer for review prior to continuing work.
- H. Refer to Section 311201 for topsoil requirements.

3.4 EXCAVATION

- A. Remove and legally dispose of material encountered to obtain required subgrade elevations, including pavement, obstructions visible on ground surface, underground structures and utilities indicated to be removed.
- B. Sloping and Benching: Follow OSHA recommendations based on soil type to determine slope configurations. Slope the sides of excavations five (5') feet deep and over to the angle of repose of the material excavated; otherwise, shore, and brace where sloping is not possible either because of space restrictions or stability of material excavated.

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- C. Bracing and Shoring:
1. Provide bracing and shoring as required in excavations, to maintain sides and to protect structures from settlement.
 2. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses.
 3. Remove shoring and bracing before completion of backfilling except where required for structural support or slope stability.
 4. The design, installation, and maintenance of such shoring and bracing required to accomplish the above purpose are the sole responsibility of the Contractor.
 5. Follow OSHA recommendations for bracing and shoring.
 6. Indemnify the Owner, the Landscape Architect, Architect, and the Consulting Engineers against any action arising from damage to existing structures, utilities or injury to persons resulting from the Contractor's actions or failure to act, in carrying out the intent of this section.
- D. Protections: Protect structures, vegetation, utilities, sidewalks, pavements, and other facilities in areas of work. Barricade and secure open excavations and provide warning lights/signage from dusk to dawn each day.
- E. Extent of Excavations: Excavate for structures to elevations and dimensions shown, extending excavation a sufficient distance to permit placing and removal of other work and for review. Trim bottom to required lines and grades to provide solid base to receive concrete or imported granular backfill material.
- F. Unsatisfactory Soil Materials: When unsatisfactory soil materials, as defined in this section, are encountered at design elevations, immediately notify the Architect in writing by email or other equally expeditious means. Continue as directed by the Architect and Geo-Technical Engineer. When conditions are not a result of Contractor's negligence, additional excavation may be directed by the Architect and paid for as a Change Order on a unit price or negotiated price basis in accordance with Contract Documents. This additional excavation shall be measured each day and verified by the Owner's representative and the Contractor's Superintendent. A daily written accounting, attested by both parties, shall be maintained with copies daily to the Architect. No claim for extra compensation will be considered except through the procedure outlined above. Assume **1,000 cy** of undercutting and removals, placement of soil stabilization fabric (SSF) and providing and compacting to 95% density imported granular backfill material in Base Bid. Unit price provided shall be utilized to add to or delete from this assumed quantity to account for actual quantity encountered.
- G. Unauthorized and Over Excavations: Fill the voids created by the removal of materials beyond indicated subgrade elevations with lean concrete (2000 psi). Or, correct by:

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1. Fill the voids created by the removal of materials beyond indicated subgrade elevations with lean concrete (2000 psi). Or;
2. Extending the indicated bottom elevation of the concrete footing to the lower elevation. Or;
3. Adding imported granular backfill material compacted to 95% density to proper design elevation and layout as directed by the Architect. Testing agency to perform compaction testing prior to proceeding.

H. Dewatering:

1. Contractor shall anticipate seasonal variations of soil moisture content and groundwater in the Base Bid as verified by site investigation indicated in Section 311201.
2. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
 - a. Surface and ground water shall be intercepted and removed before entering excavations. All necessary measures shall be taken. Earth dikes, ditches, or other devices, if required, shall be constructed to prevent such flows.
3. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - a. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - b. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.
 - c. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
4. The Contractor shall at all times provide and maintain proper and satisfactory means and devices (i.e. ditches, temporary pipes, pumps, and/or other temporary construction) for the removal of all water entering the excavations. Water shall be removed as fast as it may collect, in such manner that shall not interfere with the execution of the work or in the proper placing of pipe, structures or other work.
5. Provide and operate sufficient pumping machinery to keep excavated parts free of water. Dig sump pits when necessary into which the excavation shall be drained. Take care and proper precautions in the use of pumps so that in no case will foundations, footings and utilities already in place or existing foundations,

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footings of adjacent structures or utilities be undermined or disturbed, and erosion occur due to pumping.

6. Do not discharge pumped materials into any body of water, wetland, adjacent property, roadside swales, subsurface storm systems, or any infiltration practices as determined by the Architect. Provide temporary sediment basins, traps, and filter bags for pumped water.
 7. Adjust, repair, replace, or clean all work, surfaces, and property, which may have been affected as a result of any dewatering operation.
- I. Prepare subgrade and twelve (12") inches of existing sub-soils below subgrade elevations in excavated areas to minimum density of 95% in structure, pavement, utility areas and 90% under lawn non-paved areas.
 - J. Rock Excavation: Boulders over three (3) cu. yd., solid rock, rock in ledges, rock in trenches which cannot be ripped by a D8 dozer with a ripper, and rock- hard cementitious aggregate deposits, when encountered, shall be stockpiled for measurement before removal and paid for on a unit price basis in accordance with Contract Documents. Notify Architect immediately of rock discovery prior to performing any rock removal or continued excavation. Rock excavations as specified shall be measured each day and verified by the Owner's representative and the Contractor's Superintendent. A daily written accounting, attested to by both parties, shall be maintained with copies daily to the Architect. No claim for extra compensation will be considered except through the procedure outlined above. Assume **50 c.y.** of rock excavation and removal in Base Bid. Unit price provided shall be utilized to add to or deduct from this assumed quantity to account for actual quantity encountered. Any over excavation due to rock removal shall be handled as directed under "Over Excavation" in this Section.
 1. Contractor has the option to remove existing rock and legally dispose off-site Or;
 2. Crush existing rock and use as satisfactory earth fill when it meets gradation noted in 312201 for imported granular backfill material.

3.5 BACKFILL AND FILL

- A. Preparation of Ground Surface to Receive Fill: Remove vegetation, organic materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Break up and remove existing foundations, concrete slabs, abandoned utilities, and site features. Plow, strip, roughen, or break up slopes steeper than 1 vertical to 4 horizontal so that fill material will bond to existing surface.
- B. Execute these steps when the existing ground surface, after removal of the above unsatisfactory soil materials, has a density less than that specified under "Compaction" for the particular area classification: Break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to the required depth and percentage of maximum density.
- C. In no case shall fill be placed on a subgrade that is wet, muddy, rutted, spongy, frozen or that contains frost or that has not been tested and approved to achieve satisfactory results.

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- D. Areas to receive any fill or backfill should be properly prepared, proof rolled, tested per "Field Quality Control" within this specification, inspected and approved by the Architect and Geo-Technical Engineer prior to the placement of fill.
- E. Following grade approval by the Architect and Geo-Technical Engineer, place imported granular backfill, imported structural fill and satisfactory general earth fill material in layers not more than eight (8") inches in loose depth in a manner to minimize segregation. The fill shall be placed in nearly horizontal lifts commencing at the lowest fill area elevation and proceeding with each lift upward and outward from the lower lift.
- F. Moisture Content: Contractor shall anticipate seasonal variations of all soils (on site or imported) and imported fills moisture content in the Base Bid and timing required for such shall be included in the project schedule. The moisture content of the materials shall be adjusted prior to application of compaction such that it is no more than 1% below or 3% above the optimum moisture content of the material. Apply water to surface, subgrade or layers of soil material when required to achieve compaction densities stated below. Remove and replace, or scarify and air dry, soils or imported materials that is too wet to permit compaction to specified density.
- G. Compaction:
 - 1. Compact each eight (8") inch layer of fill and backfill materials.
 - 2. Compact fill material below subgrade for structures, slabs, pavements, and utilities to minimum 95% of optimum in place density as determined by ASTM D1557, Modified Proctor.
 - 3. Compact fill material below subgrade for lawns or unpaved areas to minimum 90% of optimum in place density as determined by ASTM D1557, Modified Proctor.
- H. Equipment:
 - 1. Use sheepsfoot rollers, pneumatic tired rollers, drum rollers, vibrating tampers, and other compaction equipment capable of obtaining the required density throughout the entire layer being compacted.
 - 2. Use power-driven hand tampers for compacting materials adjacent to site structures.
 - 3. For utility trenches or other confined areas, small compaction equipment may be necessary such as a vibratory plate, jumping jack or walk-behind vibratory roller. In these cases, lift heights no greater than six (6") inches should be maintained.
- I. Reconditioning Compacted Areas: Where previously completed compacted areas are disturbed by subsequent construction operations, traffic or adverse weather, scarify and dry out the surface, regrade, and recompact to the required density prior to further construction at no additional cost to the Owner. Use hand tamping for recompaction over underground utilities.

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3.6 STONE BLANKET (FOR SYNTHETIC TURF)

- A. Prepare subgrade under the stone drainage blanket to a smooth, firm, well-draining surface, sloped as detailed. At no time shall the subgrade be rutted by construction traffic including during the stone blanket material installation. Engage with Owner's testing agency to proof roll the turf subgrade and mark "soft spots" for additional compaction. Repair or replace areas that do not pass proof rolling test as directed by the testing agency.
- B. Install geotextile fabric, overlapping rolls a minimum of 24" at all seams. Install and secure flat drains into perimeter storm pipe with approved couplers as shown on the drawings and as specified. Secure all coupler connections with waterproof PVC tape.
- C. Handling and Placement:
 - 1. Prior to stone blanket material placement, remove any excess or contaminated backfill from the storm pipes, flat drains, and/or geotextile fabric as directed by the Architect.
 - 2. Should any separation of the materials occur during any stage of the spreading or stockpiling, the Contractor must immediately remove and dispose of segregated material and correct or change handling procedures to prevent any further separation.
 - 3. Utilize a laser plane control system for the grading of the processed stone to ensure accuracy in the grade tolerances of +0" to -1/4" in 10'-0" (measured in any direction).
 - 4. Install processed stone base, from sideline toward center-line, parallel to the flat drain network, to the lines and grades shown on the drawings. Under no circumstances shall the material be pushed more than 30'-0" from the point of discharge. Each layer must be spread uniformly with equipment that will not cause perceptible separation in gradation (segregation of the aggregates), preferably a GPS controlled low ground pressure (LPG) dozer.
 - 5. Shape the final surface of the processed stone to receive the turf system component and continue until the deviation from the required elevation does not exceed a maximum deviation from grade of +0" to -1/4" in ten feet (10'), when measured in any direction using a 10' straight-edge.
 - 6. Engage Owner's testing agency to proof roll wherever possible and mark "soft spots" for additional compaction. Use static tandem drum-type roller of not less than five (5) tons weight. Repair or replace areas that do not pass proof rolling test as directed by the testing agency.
 - 7. The stone blanket base stone shall be compacted and unyielding, as directed and approved by the Architect.

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8. Install finishing stone and roll tight to achieve an unyielding condition so that the surface shall not deviate more than 1/4" in 10' (measured in any direction) when placed under a 10' foot straight edge. This tolerance is required over the entire field.
9. On the completed stone blanket, install temporary painted lines fifteen (15') feet on center approximately on the 5 yard line and review for proper planarity. Perform "string grading" check along these 5 yard lines in the presence of the Architect and Turf Installer. Adjust high and low areas with similar stone blanket material as directed by the Architect and Turf Installer prior to placement of the turf.
10. The surface of the stone blanket course shall be well drained at all times. The permeability of the aggregate shall be checked per ASTM 2434 (constant head) testing methods. Test samples shall be as described in this specification section.
11. Once the stone blanket is in place, the testing agency shall perform permeability tests on the stone blanket in locations as directed by the Architect per EN 12616 and ASTM F2898-11. Provide water necessary for tests.
12. All test results will be logged and documented by the Contractor's Onsite Layout Foreman and Geotechnical Engineer for the testing agency. If at any time the stone blanket base does not meet project specifications, it shall be the Contractor's responsibility to restore, at his expense, the stone drainage blanket base and finishing stone to the required grade, cross section, permeability, infiltration, and density.
13. After the Contractor has independently confirmed compliance with all the above tolerances (planarity and elevation verified by a licensed surveyor and compaction, gradation, permeability, and infiltration verified by geotechnical engineer), he shall notify the Architect and schedule a final site observation for approval. The Contractor shall make available an GPS system and other equipment to the Owner's Inspection Team for the inspection process.
14. Once the stone blanket is approved by the Owner, Architect, Geotechnical Engineer, and Turf Installer, install the synthetic turf over the stone blanket as shown on the drawings, approved submittals and as specified. Prior to start of synthetic turf installation, the Turf Manufacturer/Turf Installer of the synthetic turf system shall inspect the stone blanket and supply a letter certifying base acceptance for the purposes of obtaining the Manufacturer's warranty for the synthetic turf playing surface.
15. The Site Contractor is responsible for providing daily onsite supervision of Turf Installer subcontractor at all times to ensure stone blanket planarity, drainage, and compaction is maintained during and after the turf installation.

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3.7 FIELD QUALITY CONTROL

- A. Soil Testing Service/Geo-Technical Engineer must inspect and approve density tests, retesting, and proof rolling of subgrades, as described in this section, before further construction work is performed thereon.
- B. Perform compaction density testing on compacted fill and imported granular base course in accordance with ASTM D1556, ASTM D1557, ASTM D2922, and D3017.
- C. In place density testing should be performed at a frequency of one (1) test per 500 square feet per lift in smaller open areas, one (1) test per 2,500 square feet per lift in larger open areas, and one (1) test per 25 feet per lift in confined areas and utility trenches.
- D. When the test results indicate that insufficient compaction has been obtained in any layer, the Contractor shall take action to modify or alter the moisture content in the soil, to provide additional compaction and testing or otherwise to increase the in-place soil density. If the Contractor cannot obtain satisfactory compaction due to material properties, the Contractor shall remove the unsatisfactory material and replace with new material at no additional cost to the Owner.
- E. Materials contaminated by mud, debris, organics, frost, and/or other deleterious materials shall be removed and replaced with uncontaminated specified material.
- F. No fill or backfill shall be placed over an area or lift of fill that has not be tested and achieved satisfactory results.
- G. Proof Rolling: On pavement subgrades, in cut areas only, unless otherwise directed by the Architect, the only testing required will be the proof rolling as described below:
 - 1. Provide Soil Testing Service/Geo-Technical Engineer with 48-hour advance notification when subgrades are ready to proof roll.
 - 2. Proof Roll the prepared pavement subgrade surface with fully loaded ten (10 c.y.) cubic yard earth moving truck or, in the opinion of the Architect/Geo-Technical Engineer, using a 5-ton smooth drum roller making at least 3 overlapping passes, in each of 2 perpendicular directions, on static mode at a speed of 1 to 4 feet/second. Check for unstable areas. Subgrades that rut, pump or deflect under the truck's tires may be judged unstable by the Architect/Geo-Technical Engineer. These areas may require further compaction or undercutting as directed by the Soil Testing Service/Geo-Technical Engineer.
- H. Stone Blanket Field Testing:
 - 1. Subgrade: Proof rolling and density testing for subgrade as described in Section 312201.
 - 2. Stone Blanket (for Synthetic Turf Field):
 - a. Proof rolling as described.

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- b. Permeability Test: Perform two (2) permeability test of both installed finishing and base stone as determined by ASTM D2434 confirming permeability rate outlined in "SUBMITTALS" of this specification section.
- c. Infiltrometer Tests: Engage the independent testing agency to perform permeability testing of the in-place stone blanket per EN 12616. Results shall meet the following: Direct infiltration rate of stone blanket system ≥ 40 "/hour.
 - i. Notify Architect forty-eight (48 hrs.) hours in advance and provide water, materials, machinery and labor to carry out testing in presence of Architect.
 - ii. Perform ten (10) infiltration tests each on the installed synthetic turf stone blanket in areas as directed by the Architect.
 - iii. Repair all test areas to match surrounding stone blanket material.

3.8 GUARANTEE

- A. Guarantee concrete slabs, pavements, concrete, curbs, trenches, utilities, flagpoles, structures, synthetic turf, lawns, and plant materials free from settlement for a period of one (1) year from the date given on the certificate of substantial completion or final punch list when satisfactorily completed and accepted by the Architect, whichever is later.
- B. Repair to proper grade and alignment any and all settlement of concrete slabs, pavements, concrete, curbs, trenches, utilities, flagpoles, structures, synthetic turf, track, field events, lawns and plant materials adversely affected by settlement within one (1) year after date given on the certificate of substantial completion or final punch list when satisfactorily completed and accepted by the Architect, whichever is later, at no additional expense to the Owner. In damaged compacted areas, scarify the surface, re-shape, and compact to required density prior to further construction.
- C. All repairs/corrections shall be completed to the satisfaction of the Owner within seven (7) days of written notice by the Owner.

3.9 CLEAN UP

During the contract and at intervals as directed by the Architect and as earthwork is completed, clear the site of surplus earth, large surface stones, debris, tools and equipment. Leave the site in a clean, safe, well draining, and neat condition.

END OF SECTION 312201

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SECTION 312300 - STRUCTURAL EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of structural excavation, backfill and compaction is shown on the drawings.
- B. Structural excavation, backfill and compaction includes, but is not limited to, the following:
 - 1. Layout and install batter boards and grade stakes.
 - 2. Excavation for building foundations, footings, and retaining walls as shown on the Structural Drawings.
 - 3. Bracing, shoring, and sheeting for protection of excavations.
 - 4. Pumping water from excavations.
 - 5. Backfill excavations and rough grade as indicated and required.
 - 6. Supply, place and compact
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.3 QUALITY ASSURANCE

- A. Job Safety: This is the sole responsibility of the Contractor. OSHA requirements shall be followed.

1.4 SUBMITTALS

- A. Samples:
 - 1. Slab base material: 20 lbs.
 - 2. Furnish source location and current NYSDOT acceptance number with above samples.
- B. Product Data: Manufacturer's specifications and performance data for Filter Cloth if required on the drawings.

PART 2 -PRODUCTS

2.1 MATERIALS

- A. Batter Boards: Shall be new lumber with rigid supporting members.

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- B. Backfill Inside and Outside of the Building Area: Shall be clean, well graded, NYSDOT item 304-2.02 Type 2 or run of crush stone for the top 6" and NYSDOT item 304-2.02 Type 3 below 6" of fill required.
- C. Granular slab Base: Shall be clean, well graded, NYSDOT item 304-2.02 Type 2 or washed and crushed stone, well graded from ¾" and 2" maximum size, except over footings 12" or less below finished slab on grade.
- D. Granular Slab Base: Recycled Concrete: Well graded, in conformance with NYSDOT item 304.
- E. Lean Concrete Fill: Minimum compressive strength of 1,500 psi twenty eight (28) days.
- F. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross-braces, in good serviceable condition. Use timbers that are sound and free of large or loose knots.
- G. Material Definitions:
 - 1. Satisfactory Soil Materials: Are defined as those complying with the American Association of State Highway Officials (AASHO). Designation M-145, soil classification Groups A-1, A-2-4, A-2-5, and A-3.
 - 2. Unsatisfactory Soil Materials: Are defined as those described in AASHO M-145, soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6 and A-7; also peat and other highly organic soils; and soil materials of any classifications that have a moisture content at the time of compaction beyond the range of 1% below and 3% above the optimum moisture content of the soil material, as determined by the Moisture Density Relations Test.
 - 3. Cohesionless Soil Materials: Includes gravels, sand-gravel mixture, sands and gravelly sands. Moisture density relations of Cohesionless soils, when plotted on graphs, will show straight lines or reverse-shaped moisture density curves.
 - 4. Cohesive Soil Materials: Includes clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture density curves.

PART 3 - EXECUTION

3.1 LAYOUT, LINES, LEVELS AND FIELD CHECKS

- A. The Contractor shall stake out and run levels for the building as indicated on the drawings. Erect batter boards and secure firmly against movement. Batter boards shall be protected against all hazards of damage until their use is no longer required and permission or direction is given by the Architect for their removal and disposal. Maintain carefully all bench marks, monuments, and other reference points.
- B. Lines and Levels: Run from property monuments and benchmarks.

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- C. The Contractor shall verify field conditions such as topography, inverts, location of utilities, and property lines before proceeding with the work so that changes can be made, if necessary, to accommodate the plans to the site.

3.2 GRADING

- A. Grading surface of fill under building slabs. Grade the surface of compacted existing soil or fill under the building slabs smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades with a tolerance of ¼" when tested with a ten (10') foot straight edge.

3.3 EXCAVATION

- A. Subsurface Information: Test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner, provided such operations are acceptable to the Architect and the Owner.
- B. Remove and legally dispose of material encountered to obtain required subgrade elevations, including pavement, obstructions visible on ground surface, underground structures and utilities indicated to be removed.
- C. Bracing and Shoring:
 - 1. Provide bracing and shoring as required in excavations, to maintain sides and to protect structures from settlement. Slope the sides of excavations over five (5') feet deep to the angle of repose of the material excavated; otherwise, shore, and brace where sloping is not possible either because of space restrictions or stability of material excavated.
 - 2. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses.
 - 3. Remove shoring and bracing before completion of backfilling except where required for structural support or slope stability.
 - 4. The design, installation, and maintenance of such shoring and bracing required to accomplish the above purpose are the sole responsibility of the Contractor.
 - 5. Indemnify the Owner, the Landscape Architect, Architect, and the Consulting Engineers against any action arising from damage to existing structures or injury to persons resulting from the Contractor's actions or failure to act, in carrying out the intent of this section.
- D. Protections: Protect structures, vegetation, utilities, sidewalks, pavements, and other facilities in areas of work. Barricade open excavations and provide warning lights from dusk to dawn each day.
- E. Explosives: Use of explosives will not be permitted.

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- F. Existing Utilities: Locate by hand excavation and provide protection from damage. Cooperate with the Owner and utility companies for maintaining services. Do not break utility connections without providing temporary services, as acceptable to the Architect. Repair damages to existing utilities as directed by the Utility company without additional cost to the Owner.
- G. Extent of Excavations: Excavate for structures to elevations and dimensions shown, extending excavation a sufficient distance to permit placing and removal of other work and for inspection. Trim bottom to required lines and grades to provide solid base to receive concrete.
 - 1. Footing bottoms shall be cleaned of loose materials, mud, and debris. Satisfactory bearing material loosened by construction operations or surface water shall be removed and replaced with lean concrete.
 - 2. Footing bottoms below or within two (2') feet of ground water level shall be sealed with a minimum of three (3") inch layer of lean concrete below the footing.
 - 3. If unsatisfactory soil material are encountered at design elevations, continue excavation to sound material.
 - 4. Removal of materials beyond indicated subgrade elevations shall be filled with lean concrete, or corrected by extending the indicated bottom elevation of the footing to the lower elevations, as directed by the Engineer and with no additional cost to the Owner.
- H. Notify the Soils Engineer when excavations to the contract depth are completed in order that assumed foundation bearing materials can be verified before footing concrete is placed.
- I. Pumping Equipment: Provide and operate sufficient pumping machinery to keep excavated parts free of water. Dig sump pits when necessary into which the excavation shall be drained. Take care and proper precautions in the use of pumps so that in no case will foundations already in place or existing foundations of adjacent structures be undermined or disturbed and erosion occur due to pumping.
- J. Trimming: At excavation for footings, hand trim trench bottoms to firm, hard bearing. Use "blade" type bucket.

3.4 BACKFILLING

- A. Backfill consists of placement of specified backfill material, in layers, in the excavations to the required subgrade elevations.
 - 1. Footings shall be backfilled to tops of footing immediately after removal of forms and any required concrete repairs.

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2. Backfill against walls shall not be started until required concrete repairs are made and portions of superstructure bracing the walls are in place, except if specifically approved by the Architect in writing.
 3. All backfill at exterior walls shall be pitched to drain surface water away from walls.
- B. Slab Base: In all areas where floor slabs on earth occur, after installation and approval of all piping below floors, install fill as specified herein. The subgrade and fill shall be compacted and set to proper elevations with an instrument and shall be pitched to drains as directed.

3.5 PLACEMENT AND COMPACTION

- A. Place backfill material in layers not more than eight (8") inches in loose depth. Compact each layer to required maximum density. Test each layer with spot checks as required.
- C. Compaction: Compact each layer of backfill material to 95% after proof rolling subgrade.
- D. Moisture Level: Apply water to surface or subgrade or layers of soil material if required. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
- E. Equipment: Use power-driven hand tampers for compacting materials adjacent to structures, over footings, and within the building area.
- F. Reconditioning Compacted Areas: Where complete compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, regrade, and compact to the required density prior to further construction. Use hand tamping for recompaction over underground utilities.

3.6 CLEAN UP

During the contract and at intervals as directed by the Architect and as structural excavation is completed, clear the site of surplus earth, large surface stones, debris, tools and equipment. Leave the site in a clean, safe, well draining, and neat condition.

END OF SECTION 312300

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SECTION 312501 - EROSION, SEDIMENT, AND POLLUTION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide erosion, sediment and pollution controls as shown on the drawings and as directed by the Architect to significantly reduce runoff on downstream and neighboring properties. This includes temporary control measures to mitigate land disruption by other Contractors during construction of this project.
- B. Erosion, sediment and pollution control includes, but is not limited to, the following:
 - 1. Storm structure protection
 - 2. Silt fence
 - 3. Rip rap
 - 4. Off site sediment tracking controls
 - 5. Temporary concrete washout facility
 - 6. Temporary seeding and mulching
 - 7. Permanent seeding and sodding
 - 8. Temporary basin outlet sedimentation trap
 - 9. Temporary sediment filter bag for pumped water
 - 10. Basin overflow weir
 - 11. Construction site dust control
 - 12. Spill prevention, reporting and documentation
 - 13. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.
- D. Code Compliance: The New York State Department of Environmental Conservation requires a SPDES General Permit for Storm Water Discharges from Construction Activity. This Permit GP-0-20-001 is pursuant to the Environmental Conservation Law and has penalties and fines related to violations.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 311201 - Site Preparation
- B. Section 312201 - Site Earthwork
- C. Section 329201 – Seeded and Sodded Lawns
- D. Section 334001 - Storm Drainage

1.3 REFERENCES

- A. Spill Guidelines Manual (SGM) New York State Dept. of Environmental Conservation.

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- B. New York State Standards and Specifications for Erosion and Sediment Control, dated July 2016 or latest edition.

1.4 SUBMITTALS: (See Section 311201, 1.5)

- A. Manufacturer's Data (MPD) are required for:
 - 1. Storm Structure Protection
 - 2. Silt Fence with Net Backing
 - 3. Soil Stabilization Fabric for Off Site Sediment Tracking Control
 - 4. Sediment Filter Bag
 - 5. Spill Response Equipment
- B. Material Certificates (MC) showing content/mechanical analysis and Samples are required for:
 - 1. Rip Rap
 - 2. No. 3 Stone for Off Site Sediment Tracking Control
 - 4. Temporary Seeding and Mulching: Submit seed mix species and mulch source
 - 5. Permanent Seeding & Sodding: (See Section 329201)
- C. Certification Statement: Submit photocopy of Section 312501, 1.7, filled out completely and accurately to the Landscape Architect at the pre-construction meeting.
- D. Listing of emergency contract numbers. This list shall include the name of an Emergency Response Contractor that may be used in certain situations.
- E. Per NYSDEC SPDES Regulations, all onsite contractors performing earth disturbing activities need to have current NYSDEC endorsed 4-hour erosion and sediment (E&SC) training. Provide copies of all onsite personnel certification cards, prior to construction. The document shall be kept on file (by the Contractor) within the onsite SWPPP log book.

1.5 QUALITY ASSURANCE

- A. Perform erosion, sediment and pollution control in compliance with applicable requirements of the New York Standards and Specifications Erosion and Sediment Control Manual, dated July 2016 (or latest edition) or other governing authorities having jurisdiction.
- B. Prevention of erosion and pollution from storm water runoff for the duration of this project is the responsibility of this Contractor. All Storm Water Pollution Prevention control work indicated on the drawings and/or specifications shall be included in this Contractor's Base Bid. Damages resulting from, but not limited to, negligence, improper maintenance or general disregard for erosion control measures shall be immediately corrected by this Contractor to the satisfaction of the Landscape Architect, Engineer, or Certified Erosion Control Specialist hired by the Owner for SWPPP inspections as required by NYSDEC. Damages resulting from other contractors shall be repaired by this Contractor on a time and materials basis and back charged to the responsible party. Any fines levied on the Owner by governing authorities for SWPPP violations shall be back charged to the responsible party.

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Phone No.: _____

Email: _____

2. Site Earthwork Contr. Signature: _____

Name: _____

Title: _____

Address: _____

Phone No.: _____

Email: _____

3. Site Landscaping Contr. Signature: _____

Name: _____

Title: _____

Address: _____

Phone No.: _____

Email: _____

4. Other Sub Contractors Signature: _____
as determined by the Architect

Name: _____

Title: _____

Address: _____

Phone No.: _____

Email: _____

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1.8 NOTICES

- A. The Operator (Owner) shall file with the New York State Department of Environmental Conservation (NYSDEC) a Notice of Intent (NOI) a minimum of ten (10) days prior to start of construction. Unless notified by the NYSDEC to the contrary within ten (10) days, a general SPDES permit is automatically issued which authorizes discharge of storm water on the construction site.
- B. When the site has been finally stabilized, the Operator (Owner) shall file with the NYSDEC a Notice of Termination (NOT).
- C. The Operator (Owner) is responsible for payment of annual fees related to the SPDES permit. Filing of a NOT shall typically terminate the Operator's fee responsibility.

1.9 INSPECTIONS AND MAINTENANCE

- A. The Architect or qualified personnel of the Operator shall inspect disturbed areas of the construction site at least once per week. Special attention will be focused on areas not finally stabilized, structural control measures, point discharge (outlets) and locations where vehicles enter or exit the site. Disturbed areas will be inspected for pollutants entering the drainage system. Structural control measures will be reviewed for effectiveness in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site will be inspected for evidence of off site sediment tracking. A written report of inspections shall be produced in a journal during the construction operations. The journal shall be made available (by the Operator/Owner) for NYSDEC and the general public to review.
- B. The Contractor shall provide timely maintenance of vegetation erosion and sediment control measures, and other protective measures, during construction. Corrective measures must be performed within one (1) calendar day of the Architect's or Operator's (Owner's) report. Failure by the Contractor to perform corrective work within this schedule automatically authorizes the Operator to hire others and backcharge this Contractor. The Architect or Operator will send a letter or email correspondence one (1) calendar day before hiring others and backcharging this Contractor. The Contractor shall keep a written record of maintenance and corrective work in a journal. The journal shall be made available for the Operator, Architect, Landscape Architect, Soil and Water Conservation District, ACOE, and NYSDEC until the site is finally stabilized.
- C. The Contractor shall conduct daily inspections of the equipment staging and maintenance, fueling, hazardous waste staging and waste storage areas to ensure that spill control measures are in place. Stock appropriate clean-up materials whenever changes occur in the types of chemicals used or stored on site.
- D. The Contractor is responsible for having mandatory, up to date NYSDEC endorsed 4-hour erosion and sediment control (E&SC) training all personnel working on site in accordance with the SPDES permit.
- E. The Operator (Owner) shall provide long term maintenance of the storm water facilities after the site is finally stabilized. The designated maintenance personnel shall keep written records and pictures of maintenance and corrective work in a journal. All stormwater discharge points shall be maintained, inspected, and documented. The

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journal shall be made available for review by the NYSDEC for a minimum period of five (5) years after the Notice of Termination (NOT) has been filed.

1.10 SPILL PREVENTION, REPORTING AND DOCUMENTATION

- A. To minimize the potential for discharge to the environment of oils, petroleum, or other hazardous substances, the following requirements shall apply:
 - 1. All oil, petroleum, or hazardous materials stored or temporarily relocated on site during the construction process shall be stored in a way to provide protection from vehicular damage and to provide containment of leaks or spills. Temporary berms, dikes, storage basins, or similar methods shall be employed as appropriate on site.
 - 2. Refer to Storm Water Pollution Prevention Plan Notes for additional spill prevention good housekeeping practices.
 - 3. Maintain file of Material Safety Data Sheets (MSDSs) or other references for recommended spill clean-up methods and materials.
 - 4. Keep spill response equipment readily accessible.
- B. In the event of a spill contact the Construction Manager, Owner (Operator), and Architect. The Contractor shall also notify all other Contractors working around the area of the spill.
- C. If spilled material has entered any sanitary/storm sewer system then contact the municipality or agency with jurisdiction over the system, in addition to those listed in this section.
- D. The contractor shall be responsible for the initiation of spill reporting and documentation procedures. All petroleum spills must be reported to NYSDEC Spill Hotline at 1-800-457-7362, less than two (2) hours following discovery. All petroleum spills must be reported to NYSDEC unless all of the following apply:

<u>Criteria</u>	<u>Description</u>
Quantity	Must be known to be less than 5 gallons.
Containment	Must be contained on an impervious surface or within an impervious structure. No access to the environment.
Control	Must be under control and not reach a drain or leave the impervious surface.
Cleanup	Must be cleaned-up within two (2) hours of occurrence.
Environment	Must not have already entered into soil or groundwater or onto surface water.

- E. A release of a “reportable quantity”¹ or unknown amount of a hazardous substance must also be immediately reported to the NYSDEC Spill Hotline. Spills of reportable quantities of chemicals or “harmful quantities”² of oil to navigable waters must be reported to the federal National Response Center, 1-800-424-8802 or 1-202-426-2675.

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- ¹ Reportable Quantity: Refers to the quantity of a hazardous substance or oil that triggers reporting requirements under the Comprehensive Emergency Response, Compensation, and Liability Act (CERCLA) (USEPA, September 1992).
- ² Harmful Quantity: Includes discharges that violate applicable water quality standards, cause a film, sheen, or discoloration on a water surface or adjoining shoreline; or cause a sludge or emulsion to be deposited beneath the water surface or shoreline (40 CFR 110.3).

PART 2 - PRODUCTS

2.1 STORM STRUCTURE PROTECTION

- A. Shall be a pre-manufactured cylindrical log 12” – 32” in diameter, composed of degradable geotextile mesh tube filled with compost filter media to filter sediment and other pollutants. Filter socks may be filled after placement by blowing compost into the tube pneumatically or filled at a staging location and moved into its designated location. Both ends of the filter socks shall be secured to prevent opening.
- B. The flat dimension of the sock shall be at least 1.5 times the nominal diameter of the sock.
- C. Compost infill shall be a well decomposed (matured at least 3 months), weed-free, organic matter. Shall be aerobically composted, possess no objectionable odors, and contain less than 1% by dry weight, or manmade foreign matter.
- D. All biosolids compost must meet NYS DEC’s 6NYCRR Part 360 (Solid Waste Management Facilities) requirements.
- E. When using compost filter socks adjacent to surface water, the compost should have a low nutrient value.
- F. Wood stakes shall be a minimum of 2" x 2" in size. Shall be untreated fir, redwood, cedar or pine and shall be cut from sound timbers. Shall be straight and free of loose and unsound knots or other defects which would render them as unfit for the intended use. Metal stakes may not be used as an alternate. Tops of stakes shall not extend above the top of the fiber roll.
- G. Standard of quality shall be: Diamond SOCK® pre-filled compost filter sock as manufactured by MKB Stormwater Innovation, 888-578-0777; or Architect Approved Equal

2.2 SILT FENCE

- A. Shall be a woven polypropylene geotextile comprised of UV stabilized polypropylene slit film and 1.25" square, non pressure treated, pointed, hardwood posts and net mesh backing for additional support. Standard of quality for silt fence shall be IVI-3611MW as manufactured by Indian Valley Industries, Inc., www.iviindustries.com, (607) 729-5111, or Architect approved equal.

2.3 RIP RAP

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- A. Light: Shall be placed rip rap. Stones conforming to NYSDOT Table 733-21A and the following gradations:

<u>Standard Sieve Size</u>	<u>Percent Passing by Weight</u>
Lighter than 100 lbs	90 - 100
Larger than 6"	50 - 100
Smaller than ½"	0 - 10

- B. Gradation of rip rap shall be accepted or rejected based on a visual examination by the Architect prior to placing rip rap.
- C. Soil Separation Fabric: Shall commercially manufactured non-woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by NICOLON/MIRAFI GROUP or Architect approved equal.

2.4 OFF SITE SEDIMENT TRACKING CONTROLS

- A. No. 3 stone shall meet the following requirements:

<u>Standard ASTM Sieve Size</u>	<u>Percent Passing by Weight</u>
3"	100
2"	0-15
Passing No. 50	5-10
Passing No. 100	2-5

- B. Soil Stabilization Fabric: Shall be a commercially manufactured, UV stabilized low clogging, high flow, woven geotextile. Standard of quality shall be Mirafi 600X, as manufactured by NICOLON/MIRAFI GROUP, 3500 Parkway Lane, Norcross, Georgia (Tel. 1-800-234-0484) or Architect approved equal.
- C. Granular Base Course Material: Shall be as specified in Section 312201.

2.5 TEMPORARY SEDIMENT FILTER BAG FOR PUMPED WATER

- A. Provide prefabricated bags/pouches with nonwoven geotextile fabric. The standard of quality shall be Dirtbag as manufactured by ACF Environmental, 800-448-3636 or Architect approved equal.
- B. Provide wooden pallet to set filter bag on for ease of disposal.

2.6 TEMPORARY CONCRETE WASHOUT FACILITY

- A. Concrete washout facility to fully contain all concrete washout needs of the entire project and all contracts.
- B. Concrete washout facility shall be temporary straw bales that are lined with a single sheet of a minimum of 10 mil polyethylene sheeting that extends over the entire basin to prevent escape of discharge. Place a secure, non-collapsing, non-water collecting cover

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over the concrete washout facility prior to inclement weather to prevent accumulation and overflow of precipitation.

- C. Provide concrete washout to prevent discharge from concrete trucks or equipment cleaning to inlets, surface or groundwater.
- D. Concrete washout facility shall be no closer than 50 feet from environmentally sensitive areas such as waterbodies, wetlands, and open drainage facilities and watercourses. Signs shall designate concrete washout facilities.
- E. Ensure that the concrete washout facility complies with all Federal, State and local laws, rules, and regulations. Ensure that the concrete washout facility is in place before delivery of concrete to site.
- F. Provide a sign identifying area as "Concrete Washout" acceptable to the Architect. Maintain throughout the project duration.

2.7 TEMPORARY SEEDING AND MULCHING

- A. Seeding shall be 100% Perennial Ryegrass with no more than 30% of any one cultivar and always at least 2 different cultivars and a 90% germination rate or more.
- B. All seed mixtures to contain 0.5% weed seed or less.
- C. All seed must be fresh seed, not seed that is left over from last year and beyond the sell by date.
- D. Dry mulch shall be clean straw bales.

2.8 PERMANENT SEEDING AND SODDING

Seeding and Sodding shall be as specified in Section 329201.

2.9 TEMPORARY BASIN OUTLET SEDIMENTATION TRAP

- A. Basin Outlet Sedimentation Trap shall be constructed of perforated (HDPE) pipe and clean No. 1 stone.
- B. Filter Fabric: Shall be commercially manufactured, needle-punched, non-woven geotextile, comprised of polypropylene fibers. Standard of quality shall be Mirafi 140N as manufactured by Tencate/Mirafi Group, www.tencate.com, or Architect approved equal.
- C. Concrete shall be 4,000 psi as specified in Section 321301.

2.10 BASIN OVERFLOW WEIR

- A. As detailed, the overflow weir shall be rip rap as specified in this Section or sod as specified in Section 329201.

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2.11 SPILL RESPONSE EQUIPMENT

- A. The following is a list of recommended spill control material. The contractor is responsible to have spill control and personnel protective equipment readily available for the materials being used. Acquire sufficient quantities and types of appropriate spill control materials needed to contain any spills that can be reasonably anticipated. The need for equipment to disperse, collect and contain spill control materials should be on site at all times.
1. Personal Protective Equipment
 - a. Chemical Splash Goggles
 - b. Gloves
 - c. Boot Covers
 - d. Tyvek Aprons or Suits
 2. Absorption Materials
 - a. Spill Pillows and Socks
 - b. Absorbent Booms and Pads
 - c. Dikes for use on rough surfaces
 - d. Storm Structure Covers
 - e. “Loose” Absorbents
 3. Tools
 - a. Shovel, Broom, Brush
 - b. Disposal Bags
 - c. Sealing Tape
 - d. Hazardous Waste Stickers
 - e. “Danger” and “Keep Away” Signs
 - f. Five gallon pails or 20 gallon drums with polyethylene liners
- B. Basis of Design shall be provided by: 3M, 888-364-3577; New Pig Corporation, 800-468-4647; SpillKits911, 800-474-5911; Dawg, Inc., 800-935-3294; or Architect approved equal.
- C. Place spill response equipment in a readily assessable location within or immediately adjacent to the project site.

PART 3 - EXECUTION

3.1 SIGNATURE REQUIREMENTS

- A. Between the Pre-Construction Meeting and starting site work, the Contractor shall:
1. Sign the certification statements. Contractor shall prominently display the statements at the job site.
 2. Review inspection and maintenance procedures. Decide where journals will be temporarily stored for review by NYSDEC, S&WC, ACOE, Operator (Owner), the Landscape Architect and Architect.

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3. Designate specific Owner and Contractor personnel responsible for daily inspection and maintenance. Provide certification cards.

3.2 GENERAL EROSION CONTROL

- A. Install initial construction erosion control features, as indicated on drawings and specifications or as directed by the Architect, prior to topsoil stripping, earthwork, and removal of existing vegetation. Keep the disturbance to a minimum and shall not exceed five (5) acres, unless directed by the Architect. Install other features as described in the sequence of erosion, sediment and pollution control on the drawings.
- B. Start permanent seeding and mulching within seven (7) calendar days of rough grading. When this is not possible for any reason, provide temporary seeding on non-roof, non-paved areas with 100% perennial rye grass at the rate of six pounds (6#) seed per one thousand (1,000 sf) square feet and straw mulching for complete coverage. When adverse weather conditions prevent good germination, repeat seeding and mulching as directed by the Architect until the area is stabilized. Till under temporary grass and fine grade when preparing for final permanent lawn stabilization.
- C. Until a disturbed area is stabilized, trap runoff sediment by the use of sediment debris basins, diversion swales, sediment traps, or other methods acceptable to the Architect and governing authorities. Provide temporary dry mulch (straw) to stabilize exposed soils as directed by the Architect.
- D. Provide erosion controls on slopes and swales traversing, bordering, or leaving the site. Limit the water flow to a nonerosive velocity.
- E. Do not store fill materials within one hundred (100') feet of the banks of any streams or waterbodies, intermittent or perennial.
- F. Inspect erosion and sediment control measures immediately after each rainfall and at least daily during prolonged rainfall. Make required repairs immediately.
- G. Remove sediment deposits when they reach approximately one-half of the height of the barrier. Dispose sediment in a manner that does not result in additional erosion or pollution.
- H. Provide prompt (weekly) removal and disposal of rubbish and debris in accordance with the governing authorities, Owner policies, and good housekeeping measures.
- I. Traffic shall not be permitted to cross filter socks.

3.3 MUNICIPAL SEWER, SWALES AND WETLAND EROSION CONTROL

Control erosion, siltation and pollution to municipal sewers, swales and wetlands by taking appropriate measures such as, but not limited to, the following:

- A. Do not disturb the bed and banks of waterbodies unless specifically shown on drawings. When bed and bank work is shown, obtain permits and proceed with work creating the minimum disturbance necessary to complete the project.

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- B. Prevent petroleum products and excessive amounts of silt, clay, and muck from entering municipal sewers, waters, swales or wetlands of New York State during construction.
- C. Prevent fresh concrete, concrete leachate, and washings from equipment and trucks, from entering municipal sewers, waters, swales or wetlands of New York State during construction.
- D. Place silt fence to control erosion at the downslope edge of disturbed areas. This barrier to sediments is to be put in place before disturbance of the ground occurs and is to be maintained in good condition until disturbed land is heavily vegetated or otherwise permanently stabilized.
- E. Seed areas of soil disturbance resulting from this project with appropriate perennial grass seed and mulched with straw within seven (7) calendar days as described in general erosion control. Mulch shall be maintained until a suitable vegetative ground cover is established and as directed by the Architect.

3.4 CONSTRUCTION SITE DUST CONTROL

- A. The Contractor shall prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety issues.
- B. Dust control applies to construction roads, access points, other disturbed areas and stockpiles subject to surface dust movement and dust blowing.
- C. Contractor may use any number and combination of dust control methods, as approved by the Architect. They include:
 - 1. Applying water to haul roads
 - 2. Restricting vehicle speeds to 10 mph
 - 3. Hauling materials in properly tarped or watertight containers.
 - 4. Covering stockpiles and materials
 - 5. Wetting equipment and work area
 - 6. Mulching
 - 7. Spray adhesives and polymer additives (MSDS sheets required)
 - 8. Barriers and wind breaks
- D. Contractor is responsible for any cleanup and site restoration associated with dust control measures, dust pollution on or off the project site property at no additional cost to the Owner.

3.5 STORM STRUCTURE PROTECTION

- A. Install fiber rolls as detailed around drainage structures and where shown on the plans to protect site elements from silt and sediment.
- B. Filter socks shall be anchored in earth with wooden stakes driven a minimum of 12” into the soil on 4-foot centers on the centerline of the sock. On uneven terrain, effective ground contact can be enhanced by the placement of a fillet of filter media on the disturbed area side of the compost sock.

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- C. Wrapping the storm structure grate with fabric is NOT acceptable, however straw bales may be used.
- D. Upon stabilization of the area contributory to the sock, stakes shall be removed. The sock may be left in place and vegetated or removed in accordance with the SWPPP. For removal, the mesh can be cut, and the compost spread as an additional mulch to act as a soil supplement.

3.6 SILT FENCE

- A. Locate as shown on drawings and as directed by the Architect. Excavate trench along the lower perimeter(s) of site, along the contract limit line, and as indicated on the drawings. Place excavated material on uphill side of trench for backfilling.
- B. Drive stakes securely into the downhill side of the trench. When prefabricated silt fence with fabric attached to stakes is used, drive stakes so that fabric is buried in the ground as detailed.
- C. Backfill trench with excavated material, so that fabric is securely buried in the ground to prevent undermining. Tamp soil.
- D. Join sections by overlapping fabric between two (2) stakes. Set stakes simultaneously. Overlap by minimum six (6") inches, fold, and staple to prevent sediment bypass.
- E. Attach silt fence securely to stakes spaced no more than eight (8' o.c.) feet on center. Secure fence fabric to stake with minimum three one (1") inch staples.
- F. Toward the end of the project, when site is stabilized and as directed by the Architect, remove silt fence and correct lawn area around removal to a smooth, neat, well-draining condition.

3.7 RIP RAP

- A. Place and install rip rap where shown on drawings. Do not leave jagged, sharp pieces of stone facing up.
- B. Level out stone to provide smooth transition to adjacent finish grades.

3.8 OFFSITE SEDIMENT TRACKING CONTROLS

- A. Install as detailed and shown on drawings to eliminate tracking sediment off site. Inspect after each rain storm and at the end of each work day.
- B. When sediment begins tracking off site, sweep and clean affected roadway immediately and replace stone with clean No. 3 stone to retain sediment on site.
- C. Remove fabric and stone at project completion. Complete construction of proposed final surface(s).

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3.9 TEMPORARY SEDIMENT FILTER BAG FOR PUMPED WATER

- A. Install prefabricated bags/pouches on top of straw bale base as recommended by the manufacturer. Replace system when full (discharge into bag/pouch is significantly reduced).
- B. Silt may be used as general site fill or hauled off site. Remove straw bales, fabric, and prefabricated bags/pouches off site. Regrade area and return to lawn as specified.

3.10 TEMPORARY CONCRETE WASHOUT FACILITY

- A. Install per detail in a location as approved by the Owner. Provide a stable surface, easily accessible by concrete trucks.
- B. A sign shall be installed adjacent to each washout facility to inform concrete equipment operations to utilize the proper facilities. The sign shall be installed as detailed and maintained throughout the project.
- C. Temporary concrete washout facility shall be constructed and maintained in sufficient quantity and size to contain all liquids and concrete waste generated by washout operations for the entire project and by all Contracts.
- D. Perform washout of concrete mixers, delivery trucks, and other delivery systems in designated areas only.
- E. Wash concrete only from mixer chutes into approved concrete washout facility.
- F. Plastic lining material shall be a minimum of 10-mil polyethylene sheeting and shall be free of holes, tears or other defects that compromise the impermeability of the material. Liner seams shall be installed in accordance with manufacturers' recommendations.
- G. Contents of the concrete washout facility shall not exceed 50% capacity of the facility. At or before 50% capacity is reached, discontinue pouring concrete until the facility is cleaned out. Remove hardened concrete and properly dispose off site. Allow slurry to evaporate or remove from site and dispose off site. Immediately replace the liner if it gets damaged.
- H. Remove concrete washout facility when it is no longer needed as directed by the Architect.

3.11 TEMPORARY SEEDING AND MULCHING

- A. Provide temporary seeding of topsoil stockpile immediately.
- B. When necessary and as directed by the Architect, provide temporary seeding and mulching on disturbed areas at no additional cost to the Owner.

3.12 PERMANENT SEEDING AND SODDING

- A. Install as described in Section 329201.

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3.13 TEMPORARY BASIN OUTLET SEDIMENTATION TRAP

- A. Install as detailed. Remove temporary trap and install permanent flared end section per detail near end of project when directed by the Architect.

3.14 BASIN OVERFLOW WEIR

- A. Install the specified rip rap or sod weir as detailed.
- B. Field verify elevation of overflow point as shown on drawings and confirm on as-built drawings.

3.15 SPILL RESPONSE EQUIPMENT

Use per manufacturer's recommendations and as directed by the NYSDEC, or other governing agencies.

3.16 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as erosion, sediment and pollution control procedures are completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, and neat condition.
- B. Clean storm ponding areas, catch basins and detention basins: Clean out contaminants, sediment, rubbish, construction debris, foreign objects and accumulated floatables from chambers and ponding areas thoroughly, immediately prior to final acceptance.

END OF SECTION 312501

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SECTION 321201 - ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of asphalt paving is shown on the drawings.
- B. Asphalt Paving work includes, but is not limited to, the following:
 - 1. Soil Stabilization Fabric
 - 2. Granular Base Course
 - 3. Asphaltic Concrete
 - 4. Asphalt Tack Coat
 - 5. Hot Pour Crack Sealing and Filling
 - 6. Field Quality Control
 - 7. Clean up
- C. Provide all materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 311201 - Site Preparation
- B. Section 312201 - Site Earthwork
- C. Section 334001 - Storm Drainage

1.3 REFERENCES

- A. The latest editions of the following Standards, as referenced herein, shall be applicable:
 - 1. New York State Department of Transportation Standard Specifications, Section 402 - "Hot Mix Asphalt (HMA) Pavements" and 407 - "Bituminous Tack Coat"
 - 2. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."
 - 3. American Sports Builders Association (ASBA) Asphalt Guidelines, latest edition
- B. The following reference standards shall apply for Testing and Inspection:
 - 1. ASTM D1074: Standard Test Method for Compressive Strength of Bituminous Mixtures
 - 2. ASTM D1188: Standard Test Method for Bulk Specific Gravity and Density of Compacted Mixtures Using Paraffin-Coated Specimens.
 - 3. ASTM D2041: Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
 - 4. ASTM D2726: Standard Test Method for Bulk Specific Gravity and Density of Non-absorptive Compacted Bituminous Mixtures

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5. ASTM D2950: Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
6. ASTM D3203: Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
7. ASTM D3549: Standard Test Methods for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
8. NYSDOT Materials Method 28 Friction Aggregate Control and Test Procedures

1.4 SUBMITTALS

- A. Provide Paving Contractor experience requirements, as outlined in "Quality Assurance" of this specification section, for the following:
 1. General Paving
- B. Provide Asphalt Producer Vendor Certificate and proof of quality control monitoring as outlined in "Quality Assurance" of this specification section.
- C. Provide material certificates showing content/mechanical analysis for the following:
 1. Asphaltic Concrete Mix Design:
 - a. Type/name of mix (less than 24 months old)
 - b. Gradation analysis for all aggregates
 - c. Plot (0.45 power graph) of the final aggregate blend
 - d. Bulk specific gravity of all aggregates and final aggregate blend including worksheets for natural (virgin) as well as reclaimed asphalt pavement (RAP)
 - e. Grade of asphalt binder (PG) being used
 - f. Optimum percent asphalt binder (AC)
 - g. Mix air voids at optimum
 - h. Bulk specific gravity of mix at optimum
 - i. Theoretical maximum specific gravity of mix at optimum
 - j. Voids in the Mineral Aggregate (VMA) and Void Filled with Asphalt (VFA)
 - k. Dust to total asphalt binder (AC) ratio
 - l. All design data and associated design curves
 2. Asphalt Tack Coat
- C. Provide Manufacturer's Product Data (MPD) for the following:
 1. Soil Stabilization Fabric
 2. Hot Pour Crack Sealing and Filling
- D. Submit Asphalt Placement Work Plan, indicating paving pass widths, paving directions, site access, and timing/coordination of any site equipment installation (posts, boxes, fencing, etc.) indicated in 3.3 of this specification section. Supply Owner with yield calculations for all asphalt paving products and materials used on the project as part of the work plan.

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- E. Field Quality Control test reports as indicated in this specification section.

1.5 QUALITY ASSURANCE

- A. Paving Contractor Experience Requirements:

- 1. General Paving: Contractor shall have the experience of at least five (5) years in business. Paving superintendent has a minimum of three (3) years' experience as a paving crew operating foreman.

- B. Asphalt Testing and Inspection Services:

- 1. The Owner will employ and pay for the services of an Independent Testing Agency to provide testing and inspections of asphalt pavements.
- 2. The services and the information provided by the Testing Agency are provided for the sole benefit of the Owner. The information is provided to the Contractor for the sole purpose of being aware of what is being reported.
- 3. The Contractor is solely responsible for assuring the work complies with the Contract Documents in all respects and may not rely on the testing agency for this or any other assurances. The Testing Agency and their representatives are not authorized to revoke, alter, relax, enlarge, or release any of the requirements of the Contract Documents, approve or accept any portion of the work, perform or excuse any duties of the Contractor, or be involved in the scheduling of any work.
- 4. Asphalt paving materials and operations shall be tested and inspected as the work progresses. Failure by the Testing Agency to detect any defective work or material shall not in any way prevent later rejection (when such defect is discovered) nor shall it obligate the Owner for final acceptance.

- C. Asphalt producer shall monitor production according to the procedures of NYSDOT Material Method 28 Friction Aggregate Control and Test Procedures. Asphalt producer shall be a New York State approved/certified HMA (Hot Mix Asphalt) manufacturing facility.

1.6 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.

- B. Atmospheric conditions for applying courses:

- 1. Hot mix asphalt shall generally arrive on the project site between 270°-300° F. (per asphalt producer recommendations).

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2. Place asphalt concrete wearing course or bituminous surface treatment only when atmospheric temperature is above 50 degrees F. and rising, and when asphalt binder course is thoroughly dry.
 3. Place binder course only when air temperature is above 45 degrees F. and rising and when asphalt base course or granular stone base course is thoroughly dry.
- C. Grade Control: Establish and maintain required lines and elevations.
- D. Codes and Standards: Perform the work in compliance with applicable requirements of governing authorities having jurisdiction. Obtain and pay for permits required by local authorities.
- E. Construction Review and Testing: Notify and coordinate with the Independent Testing Agency and Architect when the subgrade is shaped and ready for proof rolling. Also, when the granular base course is fully installed, compacted and ready for density testing. Protect subgrade and subbase at all times.
- F. When staging or scheduling delays occur and wearing course cannot be installed directly after binder course installation before winter, provide temporary asphalt transition ramp/collar around drainage structures in paved areas and at handicap ramps to prevent damage by snow plow. Remove prior to installation of wearing course. Power wash surface and apply asphalt tack coat, as specified, prior to wearing course installation, at no additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver all materials to the job site with all labels intact and legible at time of installation.
- B. Store materials off ground under cover. Protect from damage or deterioration.
- C. Handle materials to prevent damage to surface, edges, ends and factory applied finishes of items. Damaged material shall be rejected and replaced.

PART 2 - PRODUCTS

2.1 SOIL STABILIZATION FABRIC

- A. Shall be a heavy duty, commercially manufactured woven polypropylene geotextile. Standard of quality shall be Mirafi 500X, manufactured by TenCate or Architect approved equal.

2.2 IMPORTED GRANULAR BASE COURSE

- A. Shall be as specified in Section 312201.
- B. The graded and designed granular base below all new Asphaltic Concrete Pavements shall be constructed, tested, and prepared in accordance with Section 312201 - Site Earthwork of the Contract Documents.

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2.3 ASPHALTIC CONCRETE

- A. Paving shall consist of the following:
 - 1. Medium Duty Asphalt shall be as indicated on the plans.
- B. Hot Mix Asphalt Top Course: Pavement shall meet the minimum requirements for 9.5 mm (Type 7) SUPERPAVE Hot Mix Asphalt Top Course (75 gyrations), with a PG 64-22 Binder as specified in Section 402, of the current NYSDOT Standard Specifications, with the exception that the maximum proportion of Recycled Asphalt Pavement (RAP) to virgin aggregates shall not exceed 15% of the total mix.
- C. Hot Mix Asphalt Binder Course: Pavement shall meet the minimum requirements of 19.0mm SUPERPAVE Hot Mix Asphalt Binder Course (75 gyrations), with a PG 64-22 Binder, as specified in Section 402, of the current NYSDOT Standard Specifications, with the exception that the maximum proportion of Recycled Asphalt Pavement (RAP) to virgin aggregates shall not exceed 20% of the total mix.
- D. The coarse aggregate used in HMA shall be sound, angular crushed stone or crushed gravel. The fine aggregate shall be well graded, moderately sharp to sharp (angular) sands. No aggregates known to cause rust spots or pop-outs (steel slag, iron pyrite, and / or dust balls) are allowed in the asphalt.
- E. No pyrite or steel slag aggregates are to be within the Reclaimed Asphalt Pavement (RAP) being utilized for any of the courses above.
- F. No recycled concrete is allowed in any of the asphalt mixtures.
- G. No reclaimed asphalt shingles (RAS) are to be allowed in any basketball or tennis court asphalt.

2.4 BITUMINOUS TACK COAT

- A. Material shall consist of an asphalt emulsion, Grade RS-1h, and shall meet the minimum requirements of Section 407, of the current NYSDOT Standard Specifications. Bituminous Tack Coat shall be installed over all new and existing concrete and asphalt pavements and structures prior to the installation of new Hot Mix Asphalt materials. The following application rates shall apply:
 - 1. New Hot Mix Asphalt 0.05-0.07 gal/sy
 - 2. Milled Surfaces of Existing Asphalt 0.10-0.15 gal/sy
 - 3. Abutting Vertical Edges (drainage structures, appurtenances) 0.05-0.07 gal/sy
 - 4. All Styles of Curbs and Gutters 0.05-0.07 gal/sy
 - 5. Delayed asphalt installation of HMA Courses 0.10-0.15 gal/sy

2.5 HOT POUR CRACK SEALING AND FILLING

- A. Single component, hot applied asphalt crack and joint sealant capable of withstanding temperatures of up to 450° without experiencing polymer degradation.

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- B. Shall be supplied in solid blocks comprised of heat stabilized polymers and asphalt.
- C. Meeting the following material requirements when tested in accordance with ASTM D5329. (see chart below)

Chemical & Physical Analysis

Recommended Application Temperature	350-400°F
Maximum Heating Temperature	450°F
Cone Penetration at 25°C	50 max.
Flow at 60°C, mm	0.
Softening point	200°F Min.
Flexibility 0°F	(1" Mandrel)-Pass
Specific Gravity	1.17
Asphalt Compatibility	Passes

- C. Standard or quality shall be Crack Master Supreme as manufactured by Thorworks Industries, Inc., 800-395-7325, www.thorworks.com or approved equal.

PART 3 - EXECUTION

3.1 PREPARE SURFACE

- A. Prior to commencement of asphalt paving, all excavations, drainage, utilities, backfilling, fencing, bollards, storm structures, curbing installations, adjustments, proof-rolling and density test procedures shall be complete to the satisfaction of the Architect.
- B. Prior to commencement of tack coat and asphalt paving within pavement milled areas, as shown on the plans, all cracks and joints in the milled pavement surface shall be prepared and filled in accordance with the project specifications. Any oil or grease spots shall be scraped and treated to prevent bleeding through the tack coat.
- C. Saw cut, using straight and true lines, all existing asphalt pavements to remain in place with straight, neat edge for abutting against proposed asphalt pavement.
- D. Provide and confirm field quality control as described in Section 312201 for pavement subgrade and granular base course stone.

3.2 CONSTRUCT PAVEMENT GRANULAR BASE COURSE

- A. General: Consists of placing granular base course material, in layers of specified thickness, over prepared subgrade and fabric to support a pavement course.
- B. Grade Control: Provide engineering layout per Section 312201 and grade stakes. During construction, protect grade stakes; maintain lines and grades including crown and cross-slope of each course.
- C. Install soil stabilization fabric after subgrade has been acceptably compacted and proof rolled. Install soil stabilization fabric as recommended by the manufacturer AND;

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1. Lay fabric in direction of construction traffic.
 2. Overlap fabric side to side and end to end a minimum of two (2') feet.
 3. Establish reasonable compaction and rut stability before using heavy or vibratory compaction equipment.
- D. Placing:
1. Place granular base material over soil stabilization fabric, on prepared subgrade in layers of uniform thickness, conforming to the asphalt pavement details on the drawings.
 2. Place granular base material in a maximum of six (6) inch layers and compact with a vibratory or 10 ton smooth wheeled roller.
- E. Provide density testing as described in Section 312201.
- F. Surface Smoothness: Test finished surface for smoothness. Surface will not be acceptable when it deviates more than 3/8" measured by a 10 foot straightedge, in any direction.
- G. The finished grade of the granular base course shall be verified to ensure that the final finished product of the bituminous concrete pavement surface will be installed to the lines and grades of the existing pavements and proposed elevations surveyed by the Contractor prior to the start of the paving work.

3.3 PLACE ASPHALT MIX

- A. General:
1. The Contractor shall submit a paving plan, indicating intended direction of paving, number of pulls, etc. for approval prior to the start of paving operations.
 2. Joints: Saw cut vertical straight, neat edges for joints required. Joints shall be sharp and clean, conforming to shapes drawn on drawings. Ragged joints will not be accepted.
 3. Mill two (2') feet into surface of adjacent asphalt so joints do not line up.
 4. Place bituminous tack coat to all surfaces as indicated in this specification. When pavement surface temperature is above or below the 75-130 degrees F. range, the grade of asphalt emulsion must be modified according to NYSDOT standards. Tack coat shall not be applied to a wet surface or when the pavement surface temperature is below 45 degrees F.
 5. Place asphalt on approved prepared surface, spread and strike-off.

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6. Spread mixture at minimum temperature of 225-240 degrees F. Place inaccessible and small areas by hand. Hand work shall be minimized to ensure the best possible finished surface.
 7. Place each course to required grade, cross-section, and compacted thickness.
 8. Paving operations shall not be scheduled when ample time does not exist to place, compact, and finish roll the hot mix asphalt during daylight hours and prior to rainfall.
- B. Pavement Placing: Shall be installed in accordance with Section 402-“Hot Mix Asphalt (HMA) Pavements”, of the current NYSDOT Standard Specifications.
- C. Paving Equipment:
1. Must be capable of placing, spreading and finishing courses of HMA to the specified thickness.
 2. HMA shall be free of marks, segregation and be placed to the required uniform elevation with a smooth texture not showing tearing, shoving, or gouging.
 3. Auger extensions are required while pavers are extended beyond the basic screed width.
 4. Paving equipment shall be self-propelled and capable of maintaining the line and grade shown on the plans with suitable electronic equipment. The screed shall be straight and true with no bow and utilizing a vibratory screed. Paving equipment should have fully functional screed heaters and joint preheaters.
- D. Asphaltic Concrete shall be installed as follows:
1. Medium Duty Pavement: Installed in two (2) lifts consisting of 19.0mm SUPERPAVE Hot Mix Asphalt Binder Course overlain by 9.5mm SUPERPAVE Hot Mix Asphalt Top Course.
- E. Place in strips not less than ten (10') feet wide, unless otherwise acceptable. In placing each succeeding pass after the placement of the initial pass, the screed of the paver shall be set such that it overlaps the preceding pass by 6" and be sufficiently high such that when compacted, a smooth joint is produced. Prior to pinching the joint, the excess material shall be pushed onto the edge of the new pass with a lute. Excess material shall be removed.
- F. After first lift has been placed and rolled, place succeeding lifts and extend rolling to overlap previous lifts. Where possible, top course shall be placed at right angles to binder course and in the direction that the drainage flows. Where this is impractical, offset joints of the two courses by a minimum of two (2') feet so upper and lower joints do not align.

3.4 ROLL ASPHALT MIX

- A. General:

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1. Rollers shall conform to the manufacturer's specifications for all ballasting. At least one vibratory roller shall be required for each project, with two rollers required as a minimum. (Three rollers shall be required when tonnage is greater than 300 tons/day.)
 2. Rollers shall be of a good condition and capable of compacting the HMA to the minimum in-place density required by this specification. Compact asphalt with a nominal 10 ton steel wheel roller or pneumatic rubber tired roller. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
 3. Begin rolling when mixture will bear roller weight without obvious or excessive displacement.
- B. Finish Rolling: Each lift of the Asphaltic Concrete Pavement shall be mechanically rolled and compacted to the finished thicknesses specified in the Contract Documents. The pavements shall be compacted to a minimum of 94%-97% of the materials theoretical density as determined by AASHTO Method T 209 and an air void percentage of 5%-6% maximum.
- C. Patching: Remove and replace paving areas mixed with foreign materials, dirt, and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
- D. Joints:
1. The Contractor shall sequence the installation and orientation of all Asphaltic Concrete Pavements such that the minimum numbers of longitudinal and transverse joints are produced and in accordance with the approved Asphalt Placement Work Plan.
 2. Neat, straight butt joints between successive passes.
 3. When repairs or staging of work occurs, make neat vertical saw cut between old and new work to create butt joint. Heat joint prior to pouring. Cold joints are not acceptable.
 4. Apply bituminous tack coat to all surfaces and rates indicated under "Bituminous Tack Coat" of this specification section. Tack coat shall not be required on abutting vertical edges for pavements placed in the same day.
 5. Minimize construction, longitudinal, and transverse joints left open for an extended period of time.
 6. Construct longitudinal joints by paving in a hot fashion with a temperature of not less than 220°F to ensure maximum performance and adhesion.
 7. Compact all joints to provide for a neat, uniform and tightly bonded joint that will meet both surface tolerances and density requirements of this specification.

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8. Cut straight and true (vertical construction or transverse joints if the material has cooled to less than 220°F prior to the placement of the next pass to ensure the best performing joint possible.
- F. Edges: Roll at 45 degrees as detailed, creating clean edge conforming to shapes indicated on the drawings. Ragged edges will not be accepted. Return and saw cut ragged edges at no additional cost to the Owner as directed by the Architect.
- G. The final finished grades of the new Bituminous Concrete Pavements must be smooth and true to the contours and shall be installed to the lines and grades of the site prior to start of construction. The final finished grades shall match adjacent pavement surfaces and concrete slabs, aprons, and doorways.
- H. Construction Delays (over 48 hours): When placement of the wearing course over the binder course is delayed over 48 hours, thoroughly clean existing surface of dirt, oil and other debris by pressure washing and sweeping. Place bituminous tack coat as specified in this section.

3.5 ASPHALT TOLERANCES

- A. Thickness and Density: Compact each asphalt course to produce the thickness indicated on the drawings within the following tolerances:
 1. Binder Course: Plus or minus 1/4-inch
 2. Wearing Course: Plus or minus 1/8-inch
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 1. For Asphalt Concrete:

Base Course Surface:	3/8"
Binder Course Surface:	1/4"
Wearing Course Surface:	1/8"

3.6 FIELD QUALITY CONTROL

- A. The Owner's Testing Agency shall provide the following in the daily report at a minimum:
 1. Verify the following for the asphalt mix design prior to asphalt placement:
 - a. The asphalt mix design has been approved.
 - b. The asphalt mix design specifies the minimum relative compaction and the methods required to determine maximum density.
 2. Verify the asphalt subgrade has been acceptably proof-rolled. (See Section 312201.)

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3. Inspect /test aggregate base course material for in-place density (95%) and thickness. Test materials for gradation classification, and physical properties. (See Section 312201.)
4. Inspect/test asphalt wearing course material for compaction during placement and conduct thickness measurements during lay-down. Take temperature of the asphalt mixture and compare actual temperature with the approved asphalt mixture design range. As a minimum, perform the following inspection/tests:
 - a. Collect trip tickets from trucks delivered to the site and verify correct mix design being used for the project.
 - b. Temperature tests: one per truck.
 - c. Lay down thickness (uncompacted): one per strip or 500 square feet minimum
 - d. Verify equipment rolling pattern and passes to ensure proper compaction: one per day
 - e. Density test (daily lab density): one test per 5000 square feet minimum
 - f. Hot mix samples (laboratory testing for density per ASTM D1188): one per day
 - g. Thickness per ASTM D3549 and density samples per ASTM D2950 by a properly calibrated nuclear asphalt testing device. If there is a disagreement between tests done by ASTM D2950 and ASTM D1188, the values done by ASTM D1188 will govern: one test per 20,000 square feet (surface lift), one test per 10,000 square feet (base lift)
 - h. Air voids per ASTM D3203 or D2726: one test per 5000 square feet minimum
 - i. Verify compaction at the joints and seams. The completed paved surface to be true to grade and cross section. Verify smoothness by using an unlevelled 10 foot straightedge and ensuring no gap at any point between straightedge and pavement exceeds surface smoothness requirements above except at interception or at changes of grade.
 - j. The screed/lay down thickness tolerance shall be between 1/8 to 3/16 inches greater than the required asphalt minimum layer requirement. When screed depth is set for the exact thickness as specified, immediately notify the Owner's Representative and Contractor that the installed asphalt thickness may be deficient to achieve the specified minimum thickness. Identify areas of non-complying thickness and attach a drawing identifying the areas to the daily field report.
 - k. Immediately notify the Owner's Representative and Contractor when paving is being conducted in cold weather and asphalt temperatures are below or above the design mix range.
 - l. Check the surface grades and drainage patterns. Identify on a drawing all paved areas that are holding water after asphalt placement and notify the Owner's Representative and Contractor. Small ponding areas (bird baths) larger than two (2') feet in any dimension are not acceptable. When this test proves that surface conditions are not acceptable, the Contractor will be responsible for correcting the problem areas. Install a one (1") inch shim coat of wearing course material, or other means acceptable to the Architect.

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- m. Verify tack coat and edge coat have been applied at the proper rate.
- B. Unacceptable Paving: Remove and replace unacceptable paving as directed by the Architect, immediately and without argument or delay. Correction of deficient areas in the wearing course shall be done by sawcutting and removal of defective area of work. Tack coat shall be applied to all edges and the pavement shall be replaced. Shimming or skin patching of the wearing course shall not be permitted. Correction of deficient areas within the binder course shall be corrected by sawcutting and milling high spots, and truing and leveling low spots or as directed by the Architect.

3.7 SURFACE PROTECTION

- A. Protection: After final rolling and sealing, do not permit any type of vehicular or construction traffic on pavement until it has cooled and hardened as recommended by the producer/manufacturer, minimum of 48 hours.
- B. Provide protection including, but not limited to, fencing, traffic cones, barrels, lights, reflective signs, flagpersons and barricades until mixture has cooled and attained its maximum degree of hardness.

3.8 HOT POUR CRACK SEALING AND FILLING

- A. The crack must be free from moisture, dust, and loose aggregate. Routing or wire brushing are preferred methods followed by a compressed air heat lance immediately prior to sealing. The substrate and air temperature must be above 45°F.
- B. Shall be melted in direct fired or oil jacketed melters. Material should reach recommended pouring temperature of 350-400°F. Fresh material may be added as sealant is used.
- C. Apply heated crack filler using either a pump and wand system or a pour pot. For best results the sealant depth to width ratio should not exceed 2 to 1 (i.e. 2-inches deep to 1-inch wide). The cooled sealant height should not exceed 1/8" above surrounding pavement. Using a sealing shoe or squeegee, band the material 2 to 3 inches wide over the crack.

3.9 CLEAN UP

During the contract, and at intervals as directed by the Architect, and as asphalt paving is completed, clear the site of extraneous fabric, gravel, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 321201

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SECTION 321202 - POROUS ASPHALT PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of porous pavement is shown on the drawings.
- B. Paving work includes, but is not limited to, the following:
 - 1. Geotextile fabric
 - 2. Base Course – Stone
 - 3. Choker Course – Stone
 - 4. Porous Bituminous Asphalt
 - 5. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 311201 - Site Preparation
- B. Section 312201 - Site Earthwork
- C. Section 321201 - Asphalt Paving
- D. Section 334001 - Storm Drainage

1.3 SUBMITTALS: (See Section 311201, 1.5)

Provide material certificates showing content/mechanical analysis for the following. Provide samples only as noted:

- 1. Porous Bituminous Asphalt Mix
- 2. Base Course – Stone: Sample
- 3. Choker Course – Stone: Sample
- 4. Geotextile Fabric: Sample

1.4 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. Atmospheric conditions for applying courses:
 - 1. Place porous pavement only when atmospheric temperature is above 50 degrees F. and rising, and when base course and stone/choker stone layers are dry.
 - 2. The temperature of the bituminous mix shall be between 300 degrees F and 350 degrees F.

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- C. Grade Control: Establish and maintain required lines and elevations.

1.5 QUALITY ASSURANCE

- A. The plant Quality Control/Quality Assurance Technician shall perform all testing required in Materials Procedure 401's Sampling and Testing Matrix, including air voids testing. However, acceptance of mixture quality will be based on aggregate gradation and asphalt binder content only.
- B. The paving contractor shall have the experience of at least three (3) similar installations within the past three (3) years. These installations shall be in locations and operating conditions similar to those for this project.
- C. The existing subgrade under the porous pavement areas shall NOT be compacted or subject to excessive construction equipment traffic prior to geotextile and stone bed placement.

PART 2 – PRODUCTS

2.1 GEOTEXTILE FABRIC

- A. Shall be a heavy duty, commercially manufactured geotextile fabric consisting of needed, non-woven polypropylene fibers which meet the following properties:
 - 1. Grab Tensile Strength (ASTM-D4632) ≥ 120 lbs
 - 2. Mullen Burst Strength (ASTM-D3786) ≥ 225 psi
 - 3. Flow Rate (ASTM-D4491) ≥ 95 gal/min/ft²
 - 4. UV Resistance after 500 hours (ASTM-D4355) $\geq 70\%$
 - 5. Heat-set or heat-calendared fabrics are not permitted.
- B. Standard of quality shall be Mirafi 140N, Amoco 4547, Geotex 451 or Architect approved equal.

2.2 STONE BASE COURSE

- A. Shall be 2-inch to 1-inch uniformly graded course aggregate, with a wash loss of no more than 0.5%, AASHTO size number 3 per AASHTO Specifications, Part 1, 19th Ed., 1998, or later and shall have voids 40% as measured by ASTM-C29.

2.3 CHOKER STONE COURSE

- A. Shall be 3/8 inch to 3/4 inch clean uniformly graded course crushed aggregate AASHTO size number 57 per table 4, AASHTO Specifications, Part 1, 19th Ed., 1998 (page 47 or later).

2.4 POROUS BITUMINOUS ASPHALT

- A. Shall be a bituminous mix of 5.75% to 6% by weight dry aggregate. In accordance with ASTM-D6360, drain down of the binder shall be no greater than 0.3%. If more absorptive aggregates, such as limestone, are used in the mix, then the amount of bitumen

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is to be based on the testing procedures outlines in the National Asphalt Pavement Association’s Information Series 131 – “Porous Asphalt Pavements” (2003) or NYSDOT equivalent.

- B. Use neat asphalt binder modified with an elastomeric polymer to produce a binder meeting the requirements of PG-76-22 as specified in AASHTO MP-1. The elastomer polymer shall be styrene-butadiene-styrene (SBS), or approved equal, applied at a rate of 3% by weight of the total binder. The composite materials shall be thoroughly blended at the asphalt refinery or terminal prior to being loaded into the transport vehicles. The polymer modified asphalt binder shall be heat and storage stable.
- C. Aggregate shall be minimum 90% crushed material and have a gradation of:

<u>US Standard Sieve Size</u>	<u>Percent Passing</u>
1/2” (12.5 mm)	100
3/8” (9.5 mm)	92-98
No. 4 (4.75 mm)	34-40
No. 8 (2.36 mm)	14-20
No. 16 (1.18 mm)	7-13
No. 30 (0.60 mm)	0-4
No. 200 (0.075 mm)	0-2

2.5 HYDRATED LIME

- A. Shall be added at a dosage rate of 1.0% by weight of the total dry aggregate to mixes containing granite. Shall meet the requirements of ASTM C 977. The additive shall function to prevent the separation of the asphalt binder from the aggregate and achieve a required tensile strength ratio (TSR) of at least 80% on the asphalt mix when tested in accordance with AASHTO T 283.

PART 3 - EXECUTION

3.1 PREPARE SURFACE

- A. Saw cut existing asphalt pavements to contract limit line with straight, neat edge for joining with proposed asphalt pavement.
- B. Install stormwater management trenches per Section 334001, Storm Drainage, where shown on the drawings.
- C. Grade subgrade level and uncompacted. If new fill is required, it should consist of additional stone base course material as specified and not compacted soil.
- D. Provide field quality control as described in Section 312201, 1.3.
- E. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed with light equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rate (or equivalent) and light tractor. All fine grading shall be done by hand. All bed bottoms shall be level grade.

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- F. Install geotextile fabric after subgrade has been acceptably prepared. Including, but not limited to:
 - 1. Lay fabric in direction of construction traffic.
 - 2. Overlap fabric side to side and end to end a minimum of two feet. It shall also be secured a least 4 feet outside of bed in order to prevent any runoff or sediment from entering the storage bed. This edge strip shall remain in place until all bare soils contiguous to the pavement bed is stabilized. As the site is fully stabilized, excess geotextile along edges can be cut back to the gravel edge.
 - 3. Install 30 mil geomembrane waterstop at asphalt transitions as detailed. Protect at all times.

3.2 CONSTRUCT PAVEMENT STONE COURSE

- A. Grade Control: Provide engineering layout per Section 312201, 1.5, B. and grade stakes. During construction, protect grade stakes; maintain lines and grades of each course.
- B. Placing Stone Base Course: Place stone base course material over geotextile fabric, on prepared subgrade in layers of uniform thickness, conforming to the porous pavement detail. Place clean (washed) uniformly-graded aggregate in a maximum of eight (8) inch layers. Each layer shall be lightly compacted, with the construction equipment kept off the bed bottom as much as possible.
- C. Placing Choker Stone Course: Once base course is installed to the desired grade, place choker base course uniformly over the surface in order to provide an even surface for paving.
- D. Surface Smoothness: Test finished surface for smoothness. Surface will not be acceptable when it deviates more than 3/8" measured by a 10 foot straightedge.

3.3 PLACE POROUS PAVEMENT MIX

- A. General:
 - 1. Joints: Saw cut vertical straight, neat edges for joints required. Joints shall be sharp and clean, conforming to shapes drawn on drawings. Ragged joints will not be accepted.
 - 2. Place pavement mixture on prepared surface, spread and strike-off.
 - 3. Place inaccessible and small areas by hand.
 - 4. Place each course to required grade, cross-section, and thickness.
- B. The asphaltic mix shall be tested for its resistance to stripping by water, in accordance with ASTM D-1664. If the estimated coating area is not above 95%, anti-stripping agents shall be added to the asphalt.

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- C. Porous Pavement Placing and Compaction: Porous pavement shall be laid in two lifts directly over the stone base course to a approximately 5” uncompacted thickness. Finished result shall be a depth of 4” once compacted. It shall not be installed on wet surfaces or when ambient temperature is 50 degrees F or lower. Compaction of the surface course shall take place when the surface is cool enough to resist a 10-ton roller.

No more than two passes shall be performed as additional rolling may cause a reduction in the surface course porosity.
- D. The porous pavement mix shall not be stored in excess of 90 minutes prior to placement.
- E. Paving operations shall not be scheduled when ample time does not exist to place, compact, and finish roll the asphalt during daylight hours.

3.5 FIELD QUALITY CONTROL

- A. Surface Smoothness: Test finished surface for smoothness, 10' straightedge applied parallel with, and at right angles to, centerline of paved areas. Surfaces will not be acceptable when exceeding 1/8” tolerances for smoothness:
- B. Density Gauge: The Owner will provide density testing to ensure that the pavement is being compacted to the Project Target Density (PTD). The PTD will be determined as 81% of the Mixture’s Maximum Theoretical Density (MMTD). Perform a minimum of one density gauge reading for every 200 square feet of pavement surface placed. Acceptable in place density gauge readings at each test location will be 85% and 115% of the PTD.
- C. Porosity Test: Allow a minimum of 24 hours after completion of the Top Course, before testing. Perform a porosity test at 3 locations chosen by the Architect. At each location, test the porosity for a minimum of 3 minutes. The test is accomplished by applying clean water at the rate of at least 5 gal/min over the surface, using a hose or other distribution device. Water used for the test shall be clean, free from suspended solids and deleterious materials and will be provided at no additional cost. All applied water shall infiltrate the test panel directly, without puddle formation or surface runoff, and shall be observed by the Architect.

3.6 SURFACE PROTECTION

- A. Protection: After final rolling, no vehicular traffic shall be permitted on the surface until cooling and hardening has taken place, and in no case within the first 48 hours.
- B. Provide protection including, but not limited to reflective signs and barricades until mixture has cooled and attained its maximum degree of hardness.
- C. Cover finished porous pavement with geotextile fabric as specified above to protect from contamination. Remove prior to final acceptance.

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3.7 CLEAN UP

During the contract, and at intervals as directed by the Architect, and as porous paving is completed, clear the site of extraneous fabric, stone, asphalt and debris. Leave the site in a clean, safe, well-draining, neat condition.

END OF SECTION 321202

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SECTION 321301 - SITE CONCRETE WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of site concrete work is shown on the drawings and includes formwork, reinforcement, accessories, cast in place concrete, installation of embedded items, finishing, curing, mix designs, testing and acceptance requirements for concrete.
- B. Site Concrete work includes, but is not limited to, the following:
 - 1. Concrete walks, pads, and ramps
 - 2. Concrete turf curb
 - 3. Concrete footings, bases, and foundations
 - 4. Exterior anchoring cement non-shrink grout
 - 5. Concrete scheduling April 1 to October 15
 - 6. Clean up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 323000 Series - Site Improvements for Synthetic Turf, Site Elements, Bleachers, Scoreboard(s), Dugout(s), Fencing, Flagpoles
- C. Section 334001 - Storm Drainage

1.3 REFERENCES

- A. ACI 301-96 - Specifications of Structural Concrete for Buildings
- B. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
- C. ASTM C31 - Standard Practice for Making and Curing Test Specimens in the Field
- D. ASTM C33 - Concrete Aggregate
- E. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- F. ASTM C94 - Ready-Mixed Concrete
- G. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars
- H. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete

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- I. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
- J. ASTM C150 - Portland Cement
- K. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete
- L. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method
- M. ASTM C260 - Air Entraining Admixtures for Concrete
- N. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
- O. ACI 315 - Details and Detailing Concrete Reinforcement

1.4 SUBMITTALS: (See Section 311201, 1.5)

- A. Shop Drawings required for:
 - 1. Concrete footings / foundations showing reinforcing
- B. Manufacturers Product Data (MPD) and Samples where indicated are required for the following:
 - 1. Expansion Joint and Sealant (Vertical and Horizontal): MPD and Color Samples
 - 2. Water Based Curing and Sealing Compound
 - 3. Slip Dowel System
 - 4. Cold Weather Admixture
 - 5. Hot Weather Admixture
 - 6. Air Entrainment
 - 7. Form Release
 - 8. Exterior Anchoring Cement Non-Shrink Grout
 - 9. High Strength Anchoring Epoxy System
 - 10. Concrete Bonding Agent
- C. Submit proposed 4,500 psi concrete mix design and test data in accordance with ACI 301 to the Architect for review prior to commencement of the work.
 - 1. Indicate the locations and elements for which the mix will be used.
 - 2. Include in the concrete mix design all required or proposed admixtures necessary to facilitate the installation of the concrete by the means and methods selected by Contractor for this project.
- D. Mill test certificates and/or test reports for cement indicating compliance with these specifications.

1.5 QUALITY ASSURANCE

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- A. Concrete Testing Services: The Owner shall employ an acceptable independent testing laboratory to perform materials evaluation, testing of concrete mixes, and quality control testing. Coordinate day to day scheduling with the testing agency. Field technician shall be ACI Certified Grade 1 Field Technician.
- B. Construct and erect concrete formwork in accordance with ACI 301 and 347.
- C. Perform concrete reinforcing work in accordance with ACI 301.
- D. Perform cast-in-place concrete work in accordance with ACI 301.
- E. Conform to New York State Building Code.
- F. Field quality control tests are specified in Part 3 - Execution.

1.6 JOB CONDITIONS

- A. Job conditions in Section 312201 apply. Provide ample and skilled manpower for concrete installation which is a recognized time sensitive procedure.
- B. All concrete work shall conform to American Concrete Institute (ACI) 304R-00 "Guide for Measuring, Mixing, Transporting and Placing Concrete".
- C. Do not install concrete work when the temperature of the outside air is below 50 degrees F. and falling unless suitable means acceptable to the Architect are provided to protect work from cold and frost and ensure that mortar and concrete will cure without freezing as indicated in "Cold Weather Concreting" below.
- D. Cold Weather Concreting: Provide non-chloride accelerating water reducing admixture in site concrete work placed at ambient air temperatures below 50 degrees F. (10 degrees C.). Comply with International Masonry Industry All-Weather Council cold weather construction and protecting recommendations and American Concrete Institute 306R-10 "Guide to Cold Weather Concreting."
- E. Hot Weather: Provide water reducing retarding admixture in site concrete work placed at ambient air temperatures above 80° F. Comply with American Concrete Institute 305R-10 "Guide to Hot Weather Concreting."
- F. Construction Review: Notify the Architect/Geotechnical Engineer when stairs, retaining walls, walks, ramps, curbs and pads are formed and ready to receive concrete. Radius form layout shall be inspected and approved by the Architect.
- G. Schedule: Unless otherwise directed in writing by the Architect, construct site concrete work from April 1 to October 15. This permits a minimum 30 day dry curing period prior to possible application of deicing chemicals by the Owner.
- H. Site concrete work performed between October 16 and March 30 will require an additional written one (1) year guarantee with the understanding that above average concrete deterioration and replacement by the Contractor is likely. Or;

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Provide temporary light duty asphalt access paths and replace with permanent concrete during the following April 1 to October 15 timeframe. Both options are at no additional cost to the Owner.

1.7 ADA REQUIREMENTS

- A. GENERAL: Concrete work shall comply with the Americans With Disabilities Act as described in the 2010 ADA Standards issued by the Department of Justice (DOJ) and the Department of Transportation (DOT) or latest edition, shall be used.
- B. Curb ramp and concrete walk surfaces shall meet the following tolerances:
 - 1. Transitions from ramps to walks, gutters, or streets shall be flush and free of abrupt changes.
 - 2. Thresholds at doorways shall not exceed 3/4" in height for exterior sliding doors or 1/2" for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be beveled with a slope no greater than 1:2.
 - 3. Detectable warning system shall cast in place for the safety and convenience of the visually impaired. Contractor shall have a minimum of three (3) years experience with materials and installation.

PART 2 - PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

- A. Forms: Either steel or wood, exterior type softwood, PS1, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use forms that are straight and free of distortion and defects, extending the full depth of concrete. Concrete walks which require radius form work shall be set with flexible forms, conforming to the shapes and dimensions as indicated.
- B. Lumber: PS 20.
- C. Form Ties: Snap-off, metal type of fixed length, cone type.
 - 1. Ties shall be left in place and equipped with swaged washers or other approved devices to prevent seepage of moisture along the tie.
 - 2. Depth of Breakback: Minimum one (1") inch.
 - 3. Unless otherwise noted, provide form ties, which will not leave holes larger than one (1") inch diameter in concrete surface.
- D. Dovetail Anchor Slot: Galvanized steel, form filled, release tape sealed slots; bend tab anchors.
- E. Form Release Agent: Shall be non-staining and non-residual. Increte Wall Form Release manufactured by Increte or Architect approved equal.

2.2 REINFORCEMENT MATERIALS

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- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, plain finish, free of rust and/or oxidation. Reinforcing bars shall be bundled and tagged with grades and suitable identification markings, shall be waterproof, and shall not be removed until steel is placed.
- B. Steel Welded Wire Reinforcement ASTM A185, plain type:
 - 1. Flat Sheets
 - 2. Mesh size: 6 x 6 (standard W1.4 x W1.4, heavy duty W2.1 x W2.1)
 - 3. Free of rust and/or oxidation
- C. Reinforcement Accessories:
 - 1. Tie Wire: FS QQ- W-461 G, annealed steel, back, 16-gage minimum.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. They shall provide sufficient supports at close enough spacing so that the steel will carry the weight of the workmen and the fresh concrete without deformation from its specified location.
- D. Fabricate concrete reinforcing in accordance with ACI 315.
- E. Slip Dowels: Shall be a slip dowel system comprised of a round dowel sleeve and corresponding base. Standard of quality: shall be Speed Dowel as distributed by A.H. Harris, (860) 216-9500 or Architect approved equal.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Normal-Type 1 or Type II, Portland type.
- B. Aggregates (ASTM C33):
 - 1. Fine aggregates: clean, sharp, natural sand.
 - 2. Coarse Aggregates: 3/4" maximum size stone meeting the requirements of New York State Department of Transportation Specification 703.02.
- C. Water: Clean and not detrimental to concrete.

2.4 ADMIXTURES

- A. Calcium Chloride in concrete is prohibited.
- B. Air Entrainment Admixture: ASTM C260, Darex AEA ED or Architect approved equal.
- C. Water Reducing Admixture: ASTM C494, Type A; not containing more chloride ions than are present in municipal drinking water.
- D. High Range Water Reducing Admixture: ASTM C494, Type F or G; not containing more chloride ions than are present in municipal drinking water.

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- E. Cold Weather Accelerating Admixture: (Ambient temperature below 50°F.) Non-chloride water reducing accelerating admixture, ASTM C494, Type C, PolarSet as manufactured by WR Grace & Co. or Architect approved equal. Mix at rates recommended by the manufacturer. No reduction in compression rating of the concrete is permitted.
- F. Hot Weather Water Reducing and Retarding Admixture: (Ambient temperature above 80° F.) Shall be Daratard series admixture, ASTM C494, Type D, as manufactured by WR Grace & Co. or Architect approved equal. Mix at a rate recommended by the manufacturer. No reduction in compression rating of the concrete is permitted.

2.5 RELATED MATERIALS

- A. Expansion Joints:
 - 1. For Radius Applications: Expansion joint filler shall be polyethylene closed cell backing with peel off strip, X-Foam as manufactured by W.R. Meadows or Architect approved equal.
 - 2. For Straight Applications: Expansion joint filler shall be fiber expansion joint with peel off snap-cap, as manufactured by W.R. Meadows or Architect approved equal.
- B. Caulking for flat slabs shall be one part elastomeric self leveling polyurethane gray sealant Pourthane SL or Architect approved equal. Caulking for vertical surfaces shall be one component elastomeric gun grade polyurethane sealant Pourthane NS, color as selected by the Owner to match wall stain or Architect approved equal.

2.6 COMPOUNDS, HARDENERS, AND SEALERS

- A. Water Based, Acrylic, Curing and Sealing Compound: ASTM C309, Type 1, Class A and B, clear or translucent. Standard of quality shall be VOCOMP-20 as manufactured by W.R. Meadows or Architect approved equal.

2.7 CONCRETE MIX

- A. Mix and deliver ready-mix concrete in accordance with ASTM C94.
- B. Concrete:
 - 1. Compressive Strength (Minimum at 28 days): 4,500 psi
 - 2. Slump (Maximum): 4 inches +/- 1”
 - 3. Air Entrainment: 6.5-8.5% +/- 1.5%
 - 4. Flexural Strength (ASTM C78): 650 psi at 28 days.
- C. Use water-reducing admixture in all concrete.
- D. Water/Cement Ratio: Maximum 0.42 for 4,500 psi concrete.

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- E. Cement Factor Per Cubic yard: Minimum 560 lbs. for 4,500 psi concrete.
 - 1. Substitution of fly ash for cement is prohibited.
- F. Maximum Size of Coarse Aggregate:
 - 1. General Work: Per ACI 301, 3/4" maximum.
- G. Select admixture proportions for normal weight concrete in accordance with ACI 301.
- H. Add air-entraining agent to concrete mix for all concrete work exposed to exterior.

2.8 MIXING WATER CONTROL

- A. The quantity of mixing water used in the concrete mix shall be determined by the Contractor, except that the Architect/Geotechnical Engineer may direct that such quantity of water be reduced if the slump of the concrete exceeds the specified slump. The Contractor's determination of the quantity of mixing water shall conform to the various limits on water/cement ration and slump specified. Concrete consistency shall be uniform from batch to batch.
- B. During the course of the work, the batch plant will make quantitative measured moisture determinations of the aggregates utilized in each batch. Aggregate weights and batch water requirements shall be adjusted accordingly for measured aggregate moisture content.
- C. When concrete is transported in units approved for mixing, the addition of not more than 10% of the total design water will be permitted at the job site to obtain initial slump.
 - 1. Any addition of water shall be followed by mixing of at least 30 revolutions in the mixing speed range.
 - 2. No more than two additions of water at the point of deposition before discharge shall be allowed.
 - 3. No retempering of the concrete will be permitted. Retempering is defined as the addition of water after the mix has attained its desired initial slump.

2.9 EXTERIOR ANCHORING CEMENT (NON-SHRINK GROUT)

- A. For Steel Posts, Fencing and Other Non-Aluminum Elements: Shall be an exterior grade anchoring cement (non-shrink grout) with a min. compressive strength (ASTM C-109) of 7,200 psi at 28 days. Standard of quality shall be Super Por-Rok as manufactured by CGM, Inc., www.cgmbuildingproducts.com, or Architect approved equal.
- B. For Aluminum Posts and Elements: Shall be an exterior grade anchoring cement (non-shrink grout) with a min. compressive strength (ASTM C-109) of 7,200 psi at 28 days. Standard of quality shall be Por-Rok as manufactured by CGM, Inc., www.cgmbuildingproducts.com, or Architect approved equal.

2.10 HIGH STRENGTH ANCHORING EPOXY SYSTEM

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- A. A two-component vinylester adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment.
- B. Designed for bonding threaded rod and reinforcing bar elements into drilled holes in concrete and masonry base materials.
- C. Standard of quality shall be AC100+ GOLD Vinylester Injection Adhesive Anchoring System as distributed by A.H. Harris, (315) 414-0340, or Architect approved equal.

2.11 CONCRETE BONDING AGENT

- A. Shall be a concrete bonding adhesive specifically formulated for permanently bonding new concrete to old concrete in exterior applications.
- B. Concrete bonding adhesive applied to appropriate substrates will achieve tensile bond strengths typical of 150 psi in 28 days.
- C. Standard of quality shall be Quickrete Concrete Bonding Adhesive or Architect approved equal.

PART 3 - EXECUTION

3.1 CONCRETE WALKS, PADS, AND RAMPS

- A. Surface Preparation: Remove loose material from the compacted subgrade surface immediately before placing concrete. Remove any standing water, mud, debris, frost, snow, ice from surfaces upon or against which concrete is to be placed.
- B. Proof-roll prepared subgrade surface to check for unstable areas and the need for additional compaction. Do not begin concrete pour until such conditions have been corrected, subgrade is compacted to 95% and ready to receive concrete.
- C. Form Construction: Construct to required size and shape. Brace and secure to maintain alignment, elevation and position. Check completed formwork for grade and alignment, prior to installing concrete. Clean forms as needed to removed foreign matter.
- D. Install welded wire mesh on concrete brick or mesh chairs to proper level in maximum lengths possible. Offset end laps in both directions. Splice laps with tie wire. Lifting mesh after concrete pouring is not acceptable.
- E. Prepare concrete mixture including the following:
 - 1. Add hot weather or cold weather admixture to accommodate field weather conditions.
- F. Concrete Testing: Will be performed as described in Part 3, "Field Quality Control" of this specification section.

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- G. Conveying:
1. Convey concrete by means that will prevent segregation and loss of mortar from the mix.
 2. Provide adequate manpower and equipment in the form of buckets, buggies, chutes, conveyors or other approved means to assure continuous operation.
 3. Convey concrete so that no equipment with aluminum parts comes in contact with fresh concrete.
- H. Concrete Placement: Do not place concrete until subgrade and forms have been checked for line and grade. Moistened granular base course as required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they have been brought to the required finish grade, alignment, and expansion joints have been installed.
- I. Spread concrete as soon as it is deposited on the granular base course, using methods which prevent segregation of the mix, and with as little rehandling as possible. Consolidate concrete along the face of forms. Consolidate with care to prevent dislocation of mesh, reinforcing and joint materials.
- J. Install Concrete Walk Joints:
1. Construct expansion and contraction joints as detailed and as shown on plans. Concrete joints that do not follow the pattern(s) shown on the plans and/or changes that have been approved by the Architect will be removed and replaced at no additional cost to the Owner.
 2. When the walkway is abutting existing walks, place transverse joints to align with previously placed joints, unless otherwise shown.
 3. Contraction Joints: Approximately 5' on center. Break walk into individual slabs of not more than twenty-five (25 sf) square feet with jointing tool, round edges. Saw cut scoring pattern (contraction joints) to depth shown on details for each type of concrete work with new, sharp concrete sawblade one day (24 hours) after the pour. Joint cuts to be clean, sharp, uniformly made cuts to achieve scoring pattern as shown and detailed. Note: When tooled joints or saw cutting is not performed as described, an extended three (3 yr.) year written guarantee or credit for defective work will be required as determined by the Architect at no additional cost to the Owner.
 4. Expansion Joints: Provide where abutting building(s), columns, structures, concrete paving and curbs, catch basins, manholes, inlets, walks, walls, other fixed objects and as directed by the Architect.
 5. Locate expansion joints at thirty feet on center (30' o.c.) for each walkway lane, unless otherwise shown. Provide slip dowels as detailed and specified.
 6. Locate expansion joints with slip dowels at all flush building access points, whether specifically shown on drawings or not.
 7. Extend joint fillers full width and depth of the joint, flush with finished pavement grade, and not less than 1/4" or more than 1/2" below the finished pavement surface. Joint surfaces shall be clean and dry prior to installation of sealant as per manufacturer's recommendations. Remove excess sealant on surfaces adjacent to joint.
- K. Concrete Finishing:

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1. Perform concrete finishing using machine or hand methods as required.
2. After striking off and consolidating concrete, smooth the surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compact the surface and produce a uniform texture.
3. After floating, test surface for trueness with a ten (10') foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous, smooth finish.
4. Work edges of slabs and joints with a 1/8" radius edging tool, two (2") wide, unless otherwise shown.
5. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows.
6. Broom finish, by drawing a medium hair broom across the concrete surface as detailed. Repeat operation when required to provide a medium texture acceptable to the Architect.
7. For handicap curb ramps, tool grooves along sloping surfaces in line with drainage flow as detailed.
8. Curing: Refer to schedule noted in 1.6, above.
 - a. Immediately after placement, protect concrete from premature drying.
 - b. Remove all dirt, dust, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry.
 - c. Stir curing compound thoroughly before using.
 - d. Apply a continuous, uniform film by solvent-resistant low pressure spray only, short-nap roller or lamb's wool applicator. For best results, use a canister curing compound sprayer. Use spray tip number 8004 or equivalent for water-based or waterborne products.
 - e. For curing, apply first coat evenly and uniformly as soon as possible after final finishing. Apply second coat when all construction is completed and structure is ready for occupancy.
 - f. When soil contamination occurs, notify the Architect immediately in writing. Remove contaminated soils and legally dispose of, provide soil test(s), replace soil, plantings and lawns at no additional cost to the Owner.

3.2 CONCRETE TURF CURB

- A. General: Concrete Turf Curb shall meet the requirements specified for concrete in this Section, Item 3.1 above. Install forms true to line and grades given on plan. Provide permanent in place expansion joints using pre-molded expansion joint filler thirty feet (30' o.c.) on center, maximum. Install reinforcing bars as detailed. Remove forms in twenty-four (24) hours. Saw cut the contraction joints approximately 10' on center 1-1/2" deep with a new sharp concrete saw blade the next day after the pour along top and both faces of curb. Note: When the sawcutting is not performed as described, an extended written guarantee or credit for defective work will be required by the Architect.
- B. Finishing: Remove ties and patch tie holes, including those below grade. Remove fins and patch minor voids. Chip out major stone pockets and repair. Rub surface smooth

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with carborundum brick dipped in neat cement grout to fill pin holes. Trowelled on cement plaster is prohibited. After drying, rub off excess cement dust with burlap.

- C. Curing: See 3.1, above.

3.3 FOOTINGS, BASES, AND FOUNDATIONS

- A. Footings, Bases, Foundations: Locate and provide where shown on drawings and as detailed.

3.4 INTERRUPTION OF CONCRETING

- A. Should placing concrete be suspended or unavoidably interrupted, provide key ways and bulkheads to prevent feather-edging when work is resumed. Roughen horizontal surface for bond.

3.5 REPAIR AND PROTECTION FOR CONCRETE WORK

- A. Cut out and replace defective concrete work which has blisters, cracking, crazing, curling, discoloration, dusting, efflorescence, low spots, pop outs, scaling or mortar flaking, spalling, settling, or heaving as defined by Portland Cement Association 2001, "Concrete Slab Surface Defects" and as directed by the Architect.
- B. Modify or replace concrete not conforming to the required lines, details, elevations and specifications as directed by the Architect.
- C. Protect the work from damage until acceptance of the work. Exclude traffic from concrete work for at least fourteen (14) days after placement. When construction traffic is permitted, maintain concrete as clean as possible by removing surface stains and spillage of materials as they occur.

3.6 ANCHORING RAILINGS AND POSTS INTO CONCRETE

- A. Aluminum posts **must** be coated or treated with a good sealer or paint prior to anchoring.
- B. Drill the hole as detailed. Blow out all dust and loose particles.
- C. Fill the hole with water. Scrub the sides and bottom of the hole and with a stiff wire brush such as a bottlebrush. This is important.
- D. Remove excess water with rag or other absorbent materials. Leave the hole clean and uniformly damp.
- E. Mix the anchoring cement in a clean container to flowable consistency based on the following formula. For best results, measure accurately. The correct amount of water is as follows:

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2.3 oz per lb
11.5 oz for 5 lbs
115 oz for 50 lbs
7 quarts for 100 lbs

Measure the amount of anchoring cement and water to be mixed. Add the measured amount of water to the appropriate amount of cement and mix until the desired consistency is achieved. (NEVER USE MORE WATER THAN PRESCRIBED). This will reduce the ultimate strength, increase the possibility of volume instability and may cause the product to become soft and less durable.)

- F. Fill the hole with the plastic cement first, and then tamp the bolt, post or rod with a twisting motion into place. If the material becomes too fluid during the tamping process and sags out of place, let it stand for a few minutes and it will stiffen. Smooth out the surface around the bolt with spatula or trowel.
- G. Let the cement harden for at least 60 minutes. For heavy equipment, allow 4 hours prior to use or loading.

3.7 ANCHORING BOLTS, DOWELS, AND REBAR INTO CONCRETE

- A. Anchor Hole Preparation: Prepare all anchor holes prior to placement of anchoring epoxy. Hole diameter is typically 1/8" (3 mm) greater than the anchor diameter. Hole depth is typically nine times anchor diameter. Required minimum anchor hole depth is 6". Consult project specifications and details. Drill hole to proper diameter and depth and blow all dust from the bottom of the hole, brush and blow (4x) repeatedly to remove all dust and debris. The anchor hole must be clean and free of standing water prior to placement of material.
- B. Application: Use only professional caulking gun. Remove plastic cap and plugs from cartridge. Save for closing cartridge. Attach mixing nozzle to cartridge. Discard small amount of gunned product until uniform color is achieved. Mixing nozzle will harden in approximately 20 min. if not in use.
- C. Hardened nozzle must be discarded. Dispense the epoxy at the bottom of the hole while withdrawing nozzle. Dispense epoxy (typically filling 5/8 of hole) so that once threaded rod or rebar is inserted, the hole is completely full. Insert threaded rod or rebar to the bottom of the hole while turning clockwise. Promptly remove any excess material. Leave anchor undisturbed for 6 hours (at 77°F /25°C), or longer for colder temperatures. Load can be applied 8 hours at 77°F (25°C).

3.8 CONCRETE BONDING AGENT

- A. Required at elements where new concrete is applied and joined to existing concrete.
- B. Surface Preparation:
 - 1. Apply only to clean, sound, dry surfaces.
 - 2. Remove dust, dirt, oil, grease, wax, unsound concrete and plaster, paint, and other foreign materials.

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- C. Applications:
1. Apply to a dry surface with brush, roller or spray to the thickness of a coat of paint.
 2. Place new concrete, topping mixes, Portland cement, or patches as soon as the adhesive is dry.
 3. Make sure basecoat is dry before applying adhesive.
 4. Tools, brushes and other application accessories should be immediately cleaned with soapy water. Use hot water to clean up any drippings.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed by ACI certified technicians; Grade 1. Certificates shall be submitted to the Architect for persons performing inspection and testing prior to the start of work.
- B. Field Inspection and testing shall be paid for as directed under 1.5 "Quality Assurance". Where retesting, additional inspection, lab tests or other professional services are required due to rejected work, any cost associated therewith will be solely at the Contractor's expense.
- C. The Contractor shall plan his operations to allow adequate time for all required testing and inspection.
- D. The Contractor shall provide facilities and equipment necessary to obtain and handle representative sample of materials to be tested.
- E. The testing laboratory shall be responsible to the Owner for the field control of all concrete and may reject batches because of high slump, uncontrolled air entrainment, delays or other conditions of non-compliance with these specifications.
- F. Sampling and Field testing will be performed during concrete placement per ASTM C31, C39, C143, C172 and C173.
- G. Five (5) Concrete Test Cylinders: Taken for every 30 or less cubic yards of concrete placed are required or a fraction thereof;
1. Two (2) Cylinders will be tested at 7 days, two (2) cylinders will be tested at 28 days and one (1) cylinder will be held for possible testing at a later time.
- H. One (1) Additional Test Cylinder: Taken during cold weather concreting, to be cured on the job site under the same conditions as placed concrete it represents, is required.
- I. Air Content Test: Taken for each set of test cylinders taken, is required.
- H. One (1) Slump Test: Taken for each set of test cylinders taken is required.
- K. Test results will be reported by telephone to the General Contractor and Architect on same day tests are made. Written report with copies will follow to the Owner, Architect,

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and Landscape Architect. Email copies of laboratory test, evaluation reports for concrete materials and mix designs will be submitted.

3.10 CLEAN UP

During the contract and at intervals as directed by the Architect and as concrete work is completed, clear the site of gravel, concrete, appurtenances and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 321301

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SECTION 321801 – SYNTHETIC TURF - MULTI-PURPOSE FIELD

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of synthetic turf work is shown on the drawings.
- B. Synthetic turf work includes, but is not limited to, the following:
 - 1. Drainage blanket surface inspection and approval
 - 2. 2 ½” pile height slit film polyethylene fiber turf stitched into a primary and secondary backing.
 - 3. Tufted-in game lines and perimeter lines. Remaining required game markings and logos shall be permanently inlaid or painted as specified.
 - 4. Resilient infill system, consisting of a mixture of rubber granules and silica sand.
 - 5. Maintenance manual and onsite maintenance training
 - 6. G-max testing prior to Owner use of facility
 - 7. Twelve (12) year manufacturer's warranty
 - 8. Revisiting site for future G-max testing and infill adjustments
 - 9. Clean up
- C. Provide all labor, materials, tools and equipment necessary to install synthetic grass system as indicated on the plans and as specified.
- D. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings and submittals. The final product shall be a well-draining, even playing surface free of distortion, inconsistent infill levels, and other imperfections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 323007 –Site Elements
- C. Section 334001 - Storm Drainage

1.3 REFERENCES

- A. FM P7825 - Approved Guide; Factory Mutual Research Corporation: current edition
- B. ASTM Standard Test Methods:
 - D1577 - Standard Test Method for Linear Density of Textile Fiber
 - D5848 - Standard Test Method for Mass per Unit Area of Pile Yarn Floor Covering
 - D418 - Standard Test Method for Testing Pile Yarn Floor Covering Construction
 - D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings

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- D2256 - Standard Method of Test for Tensile Properties of Yarns by Single Strand Method
- D5034 - Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
- F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf playing Surfaces
- D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
- F355A - Standard Test Method for Shock-Absorbing Properties of Play Surfaces
- F1936 - Standard Test Method of Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
- F1551 - Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials
- F2765 - Standard Specification for Total Lead Content in Synthetic Turf Fibers

- C. National Federation of State High School Associations (NFHS) and Little League Rules and Interpretations, latest edition.
- D. Synthetic Turf Council (STC): Suggested Guidelines for the Essential Elements of Synthetic Turf Systems, latest edition and Guidelines for Crumb Rubber Used in Synthetic Turf Fields, latest edition.
- E. American Sport Builders Association (ASBA): Sports Fields - A Construction and Maintenance Manual, latest edition.

1.4 SUBMITTALS (See Section 311201, 1.5)

- A. Prior to the Architect approval of specified synthetic turf system, submit the following within seventy two (72) hours of bid opening, as requested:
 - 1. Submit two (2) 12" x 12" rag samples of proposed synthetic turf carpet and two (2) 12" x 12" boxed turf samples including infill representative of finished synthetic turf system.
 - 2. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
 - a) Specific Gravity, ASTM D792
 - b) Tuft Bind, ASTM D1335
 - c) Grab Tear Strength, ASTM D1682 or D5034
 - d) Pile Height, Face or Pile Weight & Total Fabric Weight, ASTM D418 or D5848
 - e) Primary & Secondary Backing Weights, ASTM D418 and D5848
 - f) Flammability (Pill Test), ASTM D2859
 - g) Water Permeability, ASTM F1551
 - h) Yarn Breaking Strength, ASTM D2256

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3. List of five (5) similar existing (in play) installations using the same turf fibers that have been installed in the Northeast Region of the United States including, Owner representative and telephone number(s).
 4. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a letter showing evidence that their turf system does not violate any other manufacturers' patents, patents allowed or patents pending.
 5. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide three (3) copies of a current 3rd party, NON-CANCELABLE warranty insurance policy, supported by an A-Rated domestic insurance carrier, with a policy minimum claim limit of at least \$1,000,000. and annual aggregate limit of at least \$15,000,000. in order to fully cover the full replacement of the turf system in the event of total failure. Actual policy must be submitted for approval.
 6. Letter stating the products expected useful life under normal use conditions defined in the manufacturer's warranty.
 7. A letter and specifications sheet certifying that the products in this section meet or exceed specified requirements including certification from the turf manufacturer that lead or lead chromate are not used in the manufacturing of the specified system.
- B. Submit the following prior to ordering of materials:
1. Shop Drawings (to scale) indicating:
 - a) Colored Field Layout and Field Marking plan for the specified NFHS sports.
 - b) Colored Logo / Lettering Designs and Dimensions.
 - c) Roll/Seaming Layout
 - d) Methods of attachment, field openings and perimeter conditions.
 2. Material Certificates: Provide material certificates for each material used in the turf system from the turf manufacturer that will be used for this project including, but not limited to, type and composition of fiber(s), primary and secondary backing, and urethane(s).
 3. Samples: Submit two (2) 12" x 12" samples of each turf color specified to be used for tufted and inlaid lines / logos. Tufted and Inlaid turf shall match the specified synthetic turf system. Provide two (2) bagged samples each of rubber and sand infill material.
 4. Supplier Certification that crumb rubber infill (CRI) being used for the turf system is from only used, whole, vulcanized automobile, SUV, or truck tires and produced in compliance with North American tire manufacturing specifications. Include documentation of compliance with EN-71-3 Standard for Children's Toys as indicated in Part 2, Paragraph 2.1, D.

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5. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a sample warranty that meet requirements in 1.8 of this section.
 6. Submit copies of proposed installation foreman’s resume. The installation crew must meet or exceed all the requirements outlined in Section 1.8.
 7. Manufacturer’s Product Data (MPD): Grooming Equipment, Paint, etc.
- C. Prior to Final Acceptance, the Turf Contractor shall submit to the Architect / Owner:
1. Independent G-Max test results and a letter indicating compliance with future G-Max testing as specified in 1.5 of this Section.
 2. Three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
 3. Recommended Maintenance schedule provided by vendor for first three (3) years after installation.
 4. Synthetic Turf Warranty: Submit twelve (12) year fully executed Manufacturer Warranty and ensure that forms have been completed in Owner's name and registered with Manufacturer and Insurance carrier. This includes the Certificate of Insurance from the Insurance Carrier confirming that the third-party insurance policy, non-cancelable and pre-paid is in effect covering this installation and is in force.

1.5 QUALITY ASSURANCE

- A. Turf Manufacturer Qualifications: Company specializing in manufacturing of products specified in this section. The Turf Contractor and/or the Turf Manufacturer:
1. Must be experienced in the manufacture and installation of this specific type of synthetic infill fiber grass system including fibers, backing, backing coating, adhesives, infills and installation methods at exterior sites over the last three (3) years.
 2. Must have a minimum of five (5) exterior fields installed with the same synthetic infill fiber grass system still in use and fields should be a minimum of 65,000 square feet in size.
- B. Turf Installer Qualifications: Company specializing in performing the installation work of this section.
1. The Turf Contractor must have been in business (under its’ current name and Ownership) for at least the past five (5) years and must have a minimum of twenty five (25) athletic fields still in use in the United States for a minimum of the last five (5) years.

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2. The designated Supervisory Personnel on the project must be factory certified, in writing by the Turf Manufacturer, as competent in the installation of the same synthetic infill fiber grass system, including sewing seams and proper installation of the infill mixture.
 3. The Factory Certified Supervisory Personnel shall be on site to certify the turf installation and Warranty compliance.
 4. The Turf Contractor must provide competent workmen skilled in this specific type of synthetic grass installation. The installation crew / technicians shall have experience of at least three (3) fields in play with the same synthetic infill fiber grass system being used.
- C. Prior to the beginning of the synthetic turf installation:
1. The installer of the synthetic turf shall inspect the stone drainage sub-base for tolerance to grade.
 2. String line the entire field every five (5') feet to identify high and low spots. Assist the stone drainage blanket installer with correcting any deficiencies in a proper and timely manner.
 3. The turf installer will review and confirm Owner provided project test results for stone drainage base compaction, planarity and permeability to be in compliance with project specifications as it relates to the synthetic turf warranty.
 4. The turf installer will accept the stone drainage sub-base in writing and supply a "Certificate of Base Acceptance" for the Architects approval before turf installation can begin.
- D. Shock Attenuation Evaluation (G-Max Testing):
1. Near the completion of the turf, hire a third party, independent testing agency to perform ten (10) in place G max tests in compliance with ASTM F1936 and F355A, in locations as directed by the Architect. If any test results exceeds **125**, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as directed by the Architect.
 2. Guarantee / Warranty: During the twelve (12) year guarantee period, the G max rating shall remain less than **165**. Hire a third party, independent testing agency to perform ten (10) in place G max tests, in locations as directed by the Owner, during the first, third, fifth, seventh, ninth and eleventh years. If any test results meet or exceed **165**, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as directed by the Owner. If the G max rating exceeds **165** after three (3) attempts to repair the high rating, the Turf Contractor and Turf Manufacturer shall fully replace the synthetic turf field within ninety (90) calendar days at no cost to the Owner.
- E. Materials Quality:

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1. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields used for full contact football. The materials as hereinafter specified, should be able to withstand full climatic exposure in the specific location of the field, be resistant to insect infestation, rot, fungus and mildew; it shall also withstand ultra-violet light and heat degradation, and shall have the basic non clogging characteristic of vertical flow through drainage allowing free movement of surface run-off vertically through the turf where such water may flow through the stone blanket and into the field perimeter drainage system.
2. The adhesive bonding and sewn seams of all system components shall provide a permanent, tight, secure, and hazard free athletic playing surface. All inlaid lines / markings / logos and sewn seams shall remain in place throughout the duration of the warranty period.
3. The installed synthetic turf system (turf and infill), for the life of the product, shall drain through a rate of not less than 20 inches +/- per hour.
4. Crumb Rubber Infill:
 - a. Shall not contain more than 0.01% by weight liberated fiber in accordance with the Synthetic Turf Council.
 - b. Shall not contain more than 0.1% by weight within a 100-gram sample of metal content in accordance with ASTM D5603-01.
 - c. Provide testing of every one (1) supersacks of CRI for iron content per load (or 44 bags), in accordance with ASTM D5603-01, 7.3.2. This would average 5 bags per field.
 - d. Crumb rubber infill material that does not meet the standards for ASTM D5603-01 and EN-71-3 shall be removed and replaced at no additional cost to the Owner.
5. Material that does not meet the standards shall be removed and replaced at no additional cost to the Owner.

1.6 PRE-INSTALLATION MEETING

- A. Convene One (1) Week after receipt of Submittals identified in 1.4, A. above;
 1. An interview shall take place at a time and date to be determined by the Architect at the Town Hall of the Town of DeWitt. Present at this meeting shall be the Architect, Landscape Architect, Owner's Representative(s), the Project Manager and Site Superintendent for the Prime Contractor and the Project Manager and Project Foreman for the Turf Installer. The purpose of this meeting will be to review turf product and installation means and methods, to interview and ascertain the experience and competence of the Turf Installer, as well as, the onsite Project Foreman for this project and to review the project schedule. The basis of choosing this particular product shall be in part due to the results of this interview process. Contractor shall submit all required submittals before this meeting as described in 1.4, A. above.

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- B. Convene Two (2) Weeks Prior to Stone Drainage Blanket Completion:
 - 1. A second meeting shall take place at a time and date to be determined by the Architect at the Town Hall of the Town of DeWitt. Present at this meeting shall be the Architect, Landscape Architect, Owner's Representative(s), and the Project Manager for the Prime Contractor. The purpose of this meeting shall be to review and confirm schedule. (with particular attention on the turf installation) and to confirm that the turf product has been ordered by way of notarized copies of the original confirmed Purchase Order and guaranteed delivery date.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to project site in wrapped, neat, secure condition. Provide means to unload products from delivery trucks.
- B. Store products under cover and elevated above grade. Turf and turf material left on bare ground is not acceptable to be used, and may be rejected by the Architect.
- C. Protect all products and installation area from vandalism, theft, other construction, premature use, etc. until Owner acceptance and Architect sign off.

1.8 WARRANTY

- A. The warranty coverage shall not be prorated nor place limits on the amount of the field's annual usage.
- B. The Turf Contractor and/ or Turf Manufacturer shall provide a twelve (12) year Warranty and supported by a prepaid third party insured eight (8) year warranty, from an A-rated domestic insurance carrier, which warrants the usability and playability of the artificial turf system for its intended uses. Letters of credit are not acceptable.
- C. The Turf Contractor and/or Turf Manufacturer must verify that their onsite representative has inspected the installation and that the work conforms to the Turf Manufacturer's requirements.
- D. The Warranty shall support that all designs, game markings, and layouts conform to all currently applicable National Federation State High School Association or NCAA rules and regulations, or league specific requirements, depending on application.
- E. The Warranty must have the following minimum characteristics:
 - a. Provide full coverage for a minimum of twelve (12) years from the date of Substantial Completion.
 - b. The turf fabric shall not lose more than an average 2% per year and not be limited to the amount of annual usage.

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- c. Shall guarantee the availability of replacement material for the synthetic turf system installed for the life of the warranty, including items that are no longer serviceable to maintain a serviceable and playable surface.
- d. The warranty shall be all encompassing of the turf system including, but not limited to, the fibers, backing, adhesives, infill, tape and logos.
- e. The Warranty shall include general wear including lacrosse goal crease(s) and damage caused from UV degradation.
- f. The Warranty shall specifically exclude vandalism and acts of God beyond the control of the Owner or the manufacturer.
- g. Covers defects in the installation and workmanship, and further warrant that the installation was done in accordance with both the Manufactures' recommendations and any written directives of the Manufacturer's onsite representative.
- h. Shall NOT be limited to just the repair or replacement of affected areas. Shall include all necessary materials, labor, transportation, removals, and disposal costs to complete repairs or replacement.
- i. The synthetic grass turf must maintain an ASTM F355A and ASTM F1936 G-max of between 125 and 165 for the life of the Warranty. Refer to 1.5, D. of this section.
- j. Any repairs or service to the field requested by the Owner or the Owner's representative shall be addressed within seven (7) days from the date of written notification.

1.9 MAINTENANCE SERVICE

- A. The Turf Contractor will train the Owner's facility maintenance staff in the use of the specified maintenance attachments and equipment to routinely groom, sweep and plow the field.
- B. The Turf Contractor will provide the Owner's facility maintenance staff with a recommended maintenance schedule specific for the intended level of use, etc.

1.10 EQUIVALENCY AND SUBSTITUTIONS

- A. Equivalency and Substitution Requests to follow the procedures outlined in Specification Section 012500 EQUIVALENCY.

PART 2 PRODUCTS

2.1 SYNTHETIC TURF SYSTEM

- A. The installed synthetic turf system shall have the following physical properties:

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<u>Property</u>	<u>Specification</u>	<u>ASTM</u>
Product Weight:	59 oz/sy (+/- 2 oz)	D418/D5848
Pile Yarn Weight:	36 oz/sy	D418/D5848
Fiber Denier	10,000 min.	D1577
Yarn Thickness:	100 microns min.	D3218
Pile Height:	2 ½” nominal	D418/D5848
Avg. Tuft Bind:	9+ lbs. (with infill)	D1335
Primary Backing:	7 oz/sy	D418/D5848
Secondary Backing:	16 oz/sy (urethane)	D418/D5848
Avg. Grab Tear (length)	>200 lbs./force	D5034
Avg. Grab Tear (width)	>300 lbs./force	D5034
Abrasiveness Index	<25	F1015
Permeability	>40 inches/hour	DIN 18-035-6
Pill Flammability	Pass	D2859
G Max (Impact)	≤ 125 at install, ≤ 165 over life of field	F355A / F1936
Tufting Gauge	3/4”	
Stitch Rate	4 stitches per 1”	
Field Color	Field Turf Green, Red (Clay)	
Roll Width / Length	15’ wide and up to 220’ long	
Infill (3 layer)	3 lbs/sf cryogenic ground rubber / 6.2 lbs/sf sand	
Drainage	porous non-woven fabric backing	

- B. Turf Carpet: shall consist of 100% polyethylene U.V. stabilized fibrillated slit film fiber and tufted into a primary backing (double layered polypropylene fabric treated with U.V. inhibitors) with a secondary backing with an application consisting of a minimum of 16 ounces of heat activated urethane per square yard to permanently lock the fiber tufts in place.
1. The Carpet shall be furnished in 15' wide rolls. The perimeter white line shall also be tufted into the individual sideline rolls, when applicable. The rolls shall be of sufficient length to go from sideline to sidle line without splicing. Head seams, between the sidelines, will not be acceptable. All seams will be sewn (glued seams are NOT acceptable) and thread for sewing shall be as recommended by the Turf Manufacturer.
 2. The fiber shall be low friction, UV-resistant fiber measuring not less than 2 ½” high. The same fiber from the above listed projects (Section 1.4, B.) must be used on this project.
 3. All colored inlaid lines, sport markings, numbers, and logos shall be made of the same exact monofilament fiber material as specified for the field carpet and shall be cut in and glued or “inlaid” as recommended by the Turf Manufacturer.
 4. Painting of Field Lines: If any lines are indicated to be painted, turf paint shall be Titan Synthetic Turf Marking Paint from Pioneer Paints, (800)-877-1500, or Architect approved equal.
- C. Field Markings: All markings to be installed in accordance with the Owner / Architect approved shop drawings, NFHS, Little League, and ASBA standards.

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1. Inlaid Lines: field lines to be inlaid into the turf:
 - a. Baseball and Softball: Color shall be white, except where noted.
 - 1) Infield / Base Lines
 - 2) Foul Lines
 - 3) Coaches Boxes
 - 4) Batters Boxes
 - 5) Home plates and pitching rubbers in batting cages and bull pens.
 - b. Soccer Field Tick Marks: All midfield and corner ticks shall be inlaid yellow.
 - c. Men's Lacrosse Field Tick Marks: All midfield and corner ticks shall be inlaid red.
 - d. Football Field Tick Marks: All midfield and corner ticks shall be inlaid yellow.
 - e. Softball and Baseball Outfield Fencing Tick Marks: 4" x 4" tick marks every 6'-0" +/- around the outfield fencing radius for softball and baseball shall be inlaid silver / gray.
 - f. Logos, Text, and Graphics: will be inlaid according to color and artwork, submitted by the Owner / Architect to the Turf Contractor.
 2. Painted Lines: field lines to be painted onto turf:
 - a. All lines as indicated on plans shall be painted colors as indicated on the details.
- D. Resilient Infill Three (3) Layer System: The resilient infill materials shall be approved by the Manufacturer. The infill shall consist of a resilient layered granular system of approximately 3 lbs. per square foot of cryogenically hammer-milled SBR crumb rubber and 6.2 lbs. per square foot of selected and graded dust free silica sand engineered to provide the look, feel, footing, and shock absorption of a natural grass field in ideal conditions.
1. Cryogenically ground SBR Crumb Rubber: Granules shall contain minimal dust or contaminants and shall be derived from the cryogenically hammer milled processing form of recycled tires. Color shall be substantially black and shall meet the 10 – 20, 8 – 16 or 8 – 14 mesh size designation.
 - a. The clean, uniformly sized particles shall be consistent in shape and particle size distribution.
 - b. The particles shall resist abrasion in high traffic and excessive wear applications and provide stability to artificial sports turf applications.
 - c. The particles shall be processed and sized under rigid specifications and Manufacturers' statistical and quality control assurance program.
 - d. Particles shall be structurally pure and consistently uniform in size distribution for predictable performance.
 2. SBR Crumb Rubber Certification: The Turf Contractor / Turf Manufacturer shall provide in writing that they maintain an ongoing Quality Control program

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meeting all the standards of the STC Guidelines for CRI Used in Synthetic Turf Fields and capable of meeting all specifications described herein.

- a. Turf Contractor shall supply the Architect with a copy of the Crumb Rubber Infill (CRI) Shipment / Order Certification that includes, type and origin of raw material (certify that it comes from tires), production facility, production method, fiber content (%), and (CRI) sieve / gradation analysis.
 - b. The SBR rubber infill provided for this project shall comply with the Synthetic Turf Council's recommended testing guidelines for infill based on the EN 71-3 standard for children's toys or come from a source that maintains an active Environmental Labs (UL) Environmental Claim Validation Summary showing that the rubber produced actively meets the EN 71 standard and CPSIA standard for lead. Provide written document stipulating the above.
3. Sand Particulate: The sand provided as a component of the infill mixture shall be rounded so as to minimize abrasion to the athlete and synthetic grass fibers. Supplied from either Unimin or US Silica or Architect approved equal.
- E. Inlaying Materials:
1. Adhesive for inlaying lines and markings shall be a two-component fast set urethane adhesive obtained from a single manufacturer and be equivalent to Ultrabond Turf PU 2K as manufactured by Mapei Corporation (800)-992-6273, or one-part moisture-cured polyurethane obtained from a single manufacturer and be equivalent to 34-G as manufactured by Synthetic Surfaces, Inc. (908)-233-6803 or Architect approved equal.
 2. Seaming Tape: Tape for securing inlaid lines shall be high quality tape made with a minimum roll width of twelve inches (12”).
- F. Infield: Field colors shall be red (clay) to match the existing turf fields onsite.
- G. Standard of Quality for Multi-Purpose Turf Field shall be: **Field Turf Classic HD (FTHD-1)** synthetic turf system as manufactured by:
- FieldTurf International, Inc.
Dalton, GA 30721
www.fieldturf.com
Contact: Chris White, (607)-729-8500
- Or Architect approved equal.

2.2 GROOMING and MAINTENANCE EQUIPMENT

- A. Utility Vehicle: Provide a 24.8 HP four-wheel drive (4WD) with inflatable turf type tires, 1,300lbs towing capacity, hydraulic steering, sealed hydraulic disc brakes, and tow hitch. Provide any modifications needed to connect and operate attachments with the

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utility vehicle. Standard of Quality shall be Kubota RTV X1100C Worksite as distributed by Admar Supply Co., (315) 433-5000 or Architect approved equal.

- B. Groomer: Provide a turf grooming system, which consists of spiked wheels designed to penetrate the infill in order to loosen the infill without damaging the grass fibers and light raking tines attached to the rear of the unit to groom the exposed grass fibers to keep them from matting down excessively. Standard of Quality shall be 7'-0" Wide min Turf FieldSpec Turf Groomer as distributed by Sportsfield Specialties or Architect approved equal.
- C. Sweeper: Provide field sweeper designed to clean debris off the fields. Standard of Quality shall be FieldSweep as distributed by Sportsfield Specialties or Architect approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. The installation shall be performed in full compliance with approved Shop Drawings and Submittals.
- B. Only trained technicians, skilled in the installation of outdoor athletic caliber synthetic turf systems working under the direct supervision of the Factory Certified Installation Supervisors, shall undertake any cutting, sewing, gluing, top-dressing or brushing operations.
- C. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the infill mixture.
- D. All designs, markings, layouts, and materials shall conform to all currently applicable NFHS rules and/or other rules or standard that may apply to this type of synthetic grass installation. All designs, markings and layouts must first be approved by the Architect and Owner in the form of an approved shop drawings. All markings will be installed in full compliance with those drawings.

3.2 EXAMINATION

- A. Verify that all stone drainage sub-base leveling is complete prior to installation.
- B. The surface to receive the synthetic turf shall be inspected by the Turf Contractor, and prior to the beginning of installation, the Turf Installer must accept the sub-base planarity in writing. The surface must be perfectly clean as installation commences and planarity shall be maintained to a surface tolerance that does not exceed 0"-1/4" over 10 feet and 0"-1/4" from design grade throughout the installation process by the Turf Contractor.

3.3 TURF INSTALLATION

- A. Install in accordance with Manufacturer's instructions. The Turf Contractor shall strictly adhere to the installation procedures outlined under this section. Any variance from these

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requirements must be accepted in writing, by the Manufacturer's onsite representative, and submitted to the Architect/Owner, verifying that the changes do not in any way affect the warranty or performance of the system. Infill materials shall be approved by the Manufacturer and installed in accordance with the Manufacturer's standard procedures.

- B. The carpet rolls are to be installed directly over the properly prepared stone drainage blanket or resilient pad, if applicable. Rolls shall be laid out flat a minimum of four (4) hours prior to starting seaming procedures and allowed to relax / expand. Extreme care should be taken to avoid disturbing the stone blanket or pad, both in regard to compaction and planarity. Provide a 2-5 ton static roller onsite to repair and properly stabilize any disturbed areas of the stone blanket.
- C. The full width rolls shall be laid out across the field. Turf shall be sufficient length to permit full cross-field installation from sideline to sideline. No "head" or cross seams will be allowed in the main playing area between sidelines. Utilizing standard state of the art sewing procedures each roll shall be attached to the next. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf.
- D. All seams shall be sewn using double bagger stitches and polyester thread (per the manufacturer's standard sewing procedures). Seams shall be flat, tight and permanent with no separation or fraying, for the life of the carpet.
- E. Infill materials shall be applied in numerous thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the Manufacturer or 1.75 inches within the fiber matrix. The mix shall be uniform and an even thickness to assure proper playing characteristics.
- F. The infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical. Specifically formulated rubber and sand infill shall be installed in accordance with manufactures system recommendations.
- G. Synthetic turf shall be attached to the perimeter edge detail in accordance with the Manufacturer's standard procedures and as detailed.
- H. Inlaid markings that are not tufted into the system shall be cut in and glued in accordance with synthetic turf contractors approved seaming methods for "inlaid" game markings.
- I. Prior to field acceptance, the turf shall be groomed by means of a nylon rotary brush to provide the look, feel and safety of optimally maintained natural grass, including subtle undulation normally associated with natural grass athletic fields as reviewed and approved by the Architect.
- J. The Turf Contractor shall leave the Owner two (2) full spare bags of crumb rubber/sand blend to use in topdressing the fields. Leave in a location as approved by the Owner.

3.4 CLEAN UP

- A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items to the satisfaction of the Architect / Owner.

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- B. All usable remnants of new material shall be neatly rolled up and turned over to the Owner at a place and area designated by the Owner.
- C. During the contract and at intervals as directed by the Architect and as synthetic turf installation is completed, clear the site of all extraneous materials, rubbish, or debris and leave the site in a clean, safe, well draining, neat condition.
- D. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 321801

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SECTION 321802 – SYNTHETIC TURF – SOFTBALL INFIELD

1.0 PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of synthetic turf work is shown on the drawings.
- B. Synthetic turf work includes, but is not limited to, the following:
 - 1. Drainage blanket surface inspection and approval
 - 2. 2” pile height slit film polyethylene fiber turf stitched into a primary and secondary backing.
 - 3. Tufted-in game lines and inlaid lines.
 - 4. Resilient infill system, consisting of a mixture of rubber granules and silica sand.
 - 5. Maintenance manual and onsite maintenance training
 - 6. G-max testing prior to Owner use of facility
 - 7. Twelve (12) year manufacturer's warranty
 - 8. Revisiting site for future G-max testing and infill adjustments
 - 9. Clean up
- C. Provide all labor, materials, tools, and equipment necessary to install synthetic grass system at the stand alone softball infield, all batting tunnels, and bull pens as indicated on the plans and as specified.
- D. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings and submittals. The final product shall be a well-draining, even playing surface free of distortion, inconsistent infill levels, and other imperfections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 323007 - Site Elements
- C. Section 334001 - Storm Drainage

1.3 REFERENCES

- A. FM P7825 - Approved Guide; Factory Mutual Research Corporation: current edition
- B. ASTM Standard Test Methods:
 - D1577 - Standard Test Method for Linear Density of Textile Fiber
 - D5848 - Standard Test Method for Mass per Unit Area of Pile Yarn Floor Covering
 - D418 - Standard Test Method for Testing Pile Yarn Floor Covering Construction
 - D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings

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- D2256 - Standard Method of Test for Tensile Properties of Yarns by Single Strand Method
- D5034 - Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
- F1015 - Standard Test Method for Relative Abrasiveness of Synthetic Turf playing Surfaces
- D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
- F355A - Standard Test Method for Shock-Absorbing Properties of Play Surfaces
- F1936 - Standard Test Method of Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
- F1551 - Standard Test Methods for Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials
- F2765 - Standard Specification for Total Lead Content in Synthetic Turf Fibers

- C. National Federation of State High School Associations (NFHS) Rules and Regulations, latest edition.
- D. Synthetic Turf Council (STC): Suggested Guidelines for the Essential Elements of Synthetic Turf Systems, latest edition and Guidelines for Crumb Rubber Used in Synthetic Turf Fields, latest edition.
- E. American Sport Builders Association (ASBA): Sports Fields - A Construction and Maintenance Manual, latest edition.

1.4 SUBMITTALS

- A. Prior to the Architect approval of specified synthetic turf system, submit the following within seventy-two (72) hours of bid opening, as requested:
 - 1. Submit two (2) 12” x 12” rag samples of proposed synthetic turf carpet and two (2) 12” x 12” boxed turf samples including infill representative of finished synthetic turf system.
 - 2. Submit two (2) 12” x 12” samples of proposed prefabricated porous shock pad representative of finished prefabricated porous shock pad system.
 - 3. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
 - a) Specific Gravity, ASTM D792
 - b) Tuft Bind, ASTM D1335
 - c) Grab Tear Strength, ASTM D1682 or D5034
 - d) Pile Height, Face or Pile Weight & Total Fabric Weight, ASTM D418 or D5848
 - e) Primary & Secondary Backing Weights, ASTM D418 and D5848
 - f) Flammability (Pill Test), ASTM D2859
 - g) Water Permeability, ASTM F1551

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- h) Yarn Breaking Strength, ASTM D2256
 - 4. List of five (5) similar existing (in play) installations using the same turf fibers that have been installed in the Northeast Region of the United States including, Owner representative and telephone number(s).
 - 5. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a letter showing evidence that their turf system does not violate any other manufacturers' patents, patents allowed or patents pending.
 - 6. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide three (3) copies of a current 3rd party, NON-CANCELABLE warranty insurance policy, supported by an A-Rated domestic insurance carrier, with a policy minimum claim limit of at least \$1,000,000. and annual aggregate limit of at least \$15,000,000. in order to fully cover the full replacement of the turf system in the event of total failure. Actual policy must be submitted for approval.
 - 7. Letter stating the products expected useful life under normal use conditions defined in the manufacturer's warranty.
 - 8. A letter and specifications sheet certifying that the products in this section meet or exceed specified requirements including certification from the turf manufacturer that lead or lead chromate are not used in the manufacturing of the specified system.
- B. Submit the following prior to ordering of materials:
- 1. Shop Drawings (to scale) indicating:
 - a) Colored Field Layout and Field Marking plan for the specified NFHS sports.
 - b) Colored Logo / Lettering Designs and Dimensions.
 - c) Roll/Seaming Layout
 - d) Methods of attachment, field openings and perimeter conditions.
 - 2. Material Certificates: Provide material certificates for each material used in the turf system from the turf manufacturer that will be used for this project including, but not limited to, type and composition of fiber(s), primary and secondary backing, and urethane(s).
 - 3. Samples: Submit two (2) 12" x 12" samples of each turf color specified to be used for tufted and inlaid lines / logos. Tufted and Inlaid turf shall match the specified synthetic turf system. Provide two (2) bagged samples each of rubber and sand infill material.
 - 4. Supplier Certification that crumb rubber infill (CRI) being used for the turf system is from only used, whole, vulcanized automobile, SUV, or truck tires and produced in compliance with North American tire manufacturing specifications.

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Include documentation of compliance with EN-71-3 Standard for Children's Toys as indicated in Part 2, Paragraph 2.1, D.

5. The Turf Contractor and Turf Manufacturer (if different from the company) shall provide a sample warranty that meet requirements in 1.8 of this section.
 6. Submit copies of proposed installation foreman's resume. Installation crew must meet or exceed all requirements outlined in 1.8 of this section.
 7. Manufacturer's Product Data (MPD): Prefabricated Porous Shock Pad, etc.
- C. Provide crumb rubber infill (CRI) order certification noting type and origin of raw material, production facility, production method, fiber content (%), and CRI sieve and gradation analysis. All supersacks shall provide traceability to date of production and origin of processing.
- D. No reclaimed infill, sand or rubber, from other synthetic turf field installations are permitted.
- E. Prior to Final Acceptance, the Turf Contractor shall submit to the Architect / Owner:
1. Independent G-Max test results and a letter indicating compliance with future G-Max testing as specified in 1.5 of this Section.
 2. Three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
 3. Recommended Maintenance schedule provided by vendor for first three (3) years after installation.
 4. Synthetic Turf Warranty: Submit twelve (12) year fully executed Manufacturer Warranty and ensure that forms have been completed in Owner's name and registered with Manufacturer and Insurance carrier. This includes the Certificate of Insurance from the Insurance Carrier confirming that the third-party insurance policy, non-cancelable and pre-paid is in effect covering this installation and is in force.

1.5 QUALITY ASSURANCE

- A. Turf Manufacturer Qualifications: Company specializing in manufacturing of products specified in this section. The Turf Contractor and/or the Turf Manufacturer:
1. Must be experienced in the manufacture and installation of this specific type of synthetic infill fiber grass system including fibers, backing, backing coating, adhesives, infills and installation methods at exterior sites over the last three (3) years.

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2. Must have a minimum of five (5) exterior fields installed with the same synthetic infill fiber grass system still in use and fields should be a minimum of 65,000 square feet in size.
- B. Turf Installer Qualifications: Company specializing in performing the installation work of this section.
1. The Turf Contractor must have been in business (under its' current name and Ownership) for at least the past five (5) years and must have a minimum of twenty five (25) athletic fields still in use in the United States for a minimum of the last five (5) years.
 2. The designated Supervisory Personnel on the project must be factory certified, in writing by the Turf Manufacturer, as competent in the installation of the same synthetic infill fiber grass system, including sewing seams and proper installation of the infill mixture.
 3. The Factory Certified Supervisory Personnel shall be on site to certify the turf installation and Warranty compliance.
 4. The Turf Contractor must provide competent workmen skilled in this specific type of synthetic grass installation. The installation crew / technicians shall have experience of at least three (3) fields in play with the same synthetic infill fiber grass system being used.
- C. Prior to the beginning of the synthetic turf installation:
1. The installer of the synthetic turf shall inspect the stone drainage sub-base for tolerance to grade.
 2. String line the entire field every five (5') feet to identify high and low spots. Assist the stone drainage blanket installer with correcting any deficiencies in a proper and timely manner.
 3. The turf installer will review and confirm Owner provided project test results for stone drainage base compaction, planarity and permeability to be in compliance with project specifications as it relates to the synthetic turf warranty.
 4. The turf installer will accept the stone drainage sub-base in writing and supply a "Certificate of Base Acceptance" for the Architects approval before turf installation can begin.
- D. Shock Attenuation Evaluation (G-Max Testing):
1. Near the completion of the turf, hire a third party, independent testing agency to perform ten (10) in place G max tests in compliance with ASTM F1936 and F355A, in locations as directed by the Architect. If any test results exceeds **125**, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as directed by the Architect.

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2. Guarantee / Warranty: During the twelve (12) year guarantee period, the G max rating shall remain less than **165**. Hire a third party, independent testing agency to perform ten (10) in place G max tests, in locations as directed by the Owner, during the first, third, fifth, seventh, ninth and eleventh years. If any test results meet or exceed **165**, modify the infill material ratios as necessary to achieve satisfactory results. Perform additional testing to verify the results as directed by the Owner. If the G max rating exceeds **165** after three (3) attempts to repair the high rating, the Turf Contractor and Turf Manufacturer shall fully replace the synthetic turf field within ninety (90) calendar days at no cost to the Owner.

E. Materials Quality:

1. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields used for full contact football. The materials as hereinafter specified, should be able to withstand full climatic exposure in the specific location of the field, be resistant to insect infestation, rot, fungus and mildew; it shall also withstand ultra-violet light and heat degradation, and shall have the basic non clogging characteristic of vertical flow through drainage allowing free movement of surface run-off vertically through the turf where such water may flow through the stone blanket and into the field perimeter drainage system.
2. The adhesive bonding and sewn seams of all system components shall provide a permanent, tight, secure, and hazard free athletic playing surface. All inlaid lines / markings / logos and sewn seams shall remain in place throughout the duration of the warranty period.
3. The installed synthetic turf system (turf and infill), for the life of the product, shall drain through a rate of not less than 20 inches +/- per hour.
4. Crumb Rubber Infill:
 - a. Shall not contain more than 0.01% by weight liberated fiber in accordance with the Synthetic Turf Council.
 - b. Shall not contain more than 0.1% by weight within a 100-gram sample of metal content in accordance with ASTM D5603-01.
 - c. Provide testing of every one (1) supersacks of CRI for iron content per load (or 44 bags), in accordance with ASTM D5603-01, 7.3.2. This would average 5 bags per field.
 - d. Crumb rubber infill material that does not meet the standards for ASTM D5603-01 and EN-71-3 shall be removed and replaced at no additional cost to the Owner.
5. Material that does not meet the standards shall be removed and replaced at no additional cost to the Owner.

F. Porous Shock Pad:

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1. The porous shock pad shall have a proven track record of performance for consistent playability, long-term G-max and longevity. Provide examples of three (3) fields in play within the past year using the porous shock pad under a sand rubber infill mix turf system.
2. The porous shock pad must be proven to have last at least two (2) life cycles. Submit list of three (3) installations where the proposed shock pad is currently being used for its second life cycle.
3. Installation Foreman shall have experience of at least three (3) installation with sewn seams and true inlays over this type of shock pad in the last year. Submit experience locations, names and contact information for review.

1.6 PRE-INSTALLATION MEETING

- A. Convene One (1) Week after receipt of Submittals identified in 1.4, A. above;
 1. An interview shall take place at a time and date to be determined by the Architect at the Town of DeWitt. Present at this meeting shall be the Architect, Landscape Architect, Owner's Representative(s), the Project Manager and Site Superintendent for the Prime Contractor and the Project Manager and Project Foreman for the Turf Installer. The purpose of this meeting will be to review turf product and installation means and methods, to interview and ascertain the experience and competence of the Turf Installer, as well as, the onsite Project Foreman for this project and to review the project schedule. The basis of choosing this particular product shall be in part due to the results of this interview process. Contractor shall submit all required submittals before this meeting as described in 1.4, A. above.
- B. Convene Two (2) Weeks Prior to Stone Drainage Blanket Completion:
 1. A second meeting shall take place at a time and date to be determined by the Architect at the Town of DeWitt. Present at this meeting shall be the Architect, Landscape Architect, Owner's Representative(s), and the Project Manager for the Prime Contractor. The purpose of this meeting shall be to review and confirm schedule. (with particular attention on the turf installation) and to confirm that the turf product has been ordered by way of notarized copies of the original confirmed Purchase Order and guaranteed delivery date.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to project site in wrapped, neat, secure condition. Provide means to unload products from delivery trucks.
- B. Store products under cover and elevated above grade. Turf and turf material left on bare ground is not acceptable to be used, and may be rejected by the Architect.
- C. Protect all products and installation area from vandalism, theft, other construction, premature use, etc. until Owner acceptance and Architect sign off.

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1.8 WARRANTY

- A. The warranty coverage shall not be prorated nor place limits on the amount of the field's annual usage.
- B. The Turf Contractor and/ or Turf Manufacturer shall provide a twelve (12) year Warranty and supported by a prepaid third party insured eight (8) year warranty, from an A-rated domestic insurance carrier, which warrants the usability and playability of the artificial turf system for its intended uses. Letters of credit are not acceptable.
- C. The Turf Contractor and/or Turf Manufacturer must verify that their onsite representative has inspected the installation and that the work conforms to the Turf Manufacturer's requirements.
- D. The Warranty shall support that all designs, game markings, and layouts conform to all currently applicable National Federation State High School Association or NFHS rules and regulations, or league specific requirements, depending on application.
- E. The Warranty must have the following minimum characteristics:
 - a. Provide full coverage for a minimum of twelve (12) years from the date of Substantial Completion.
 - b. The turf fabric shall not lose more than an average 2% per year and not be limited to the amount of annual usage.
 - c. Shall guarantee the availability of replacement material for the synthetic turf system installed for the life of the warranty, including items that are no longer serviceable to maintain a serviceable and playable surface.
 - d. The warranty shall be all encompassing of the turf system including, but not limited to, the fibers, backing, adhesives, infill, tape and logos.
 - e. The Warranty shall include general wear including lacrosse goal crease(s) and damage caused from UV degradation.
 - f. The Warranty shall specifically exclude vandalism, and acts of God beyond the control of the Owner or the manufacturer.
 - g. Covers defects in the installation and workmanship, and further warrant that the installation was done in accordance with both the Manufactures' recommendations and any written directives of the Manufacturer's onsite representative.
 - h. Shall NOT be limited to just the repair or replacement of affected areas. Shall include all necessary materials, labor, transportation, removals, and disposal costs to complete repairs or replacement.

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- i. The synthetic grass turf must maintain an ASTM F355A and ASTM F1936 G-max of between 125 and 165 for the life of the Warranty. Refer to 1.5, D. of this section.
- j. Any repairs or service to the field requested by the Owner or the Owner's representative shall be addressed within seven (7) days from the date of written notification.

1.9 MAINTENANCE SERVICE

- A. The Turf Contractor will train the Owner's facility maintenance staff in the use of the specified maintenance attachments and equipment to routinely groom, sweep and plow the field.
- B. The Turf Contractor will provide the Owner's facility maintenance staff with a recommended maintenance schedule specific for the intended level of use, etc.

1.10 EQUIVALENCY AND SUBSTITUTIONS

- A. Equivalency and Substitution Requests to follow the procedures outlined in Specification Section 012500 EQUIVALENCY.

2.0 PART 2 PRODUCTS

2.1 SYNTHETIC TURF SYSTEM

- A. The installed synthetic turf system shall have the following physical properties:

<u>Property</u>	<u>Specification</u>	<u>ASTM</u>
Product Weight:	77 oz/sy (+/- 2 oz)	D418/D5848
Pile Yarn Weight:	50 oz/sy (+/- 2 oz)	D418/D5848
Fiber Denier	10,000 min.	D1577
Yarn Thickness:	100 microns min.	D3218
Pile Height:	2" nominal	D418/D5848
Avg. Tuft Bind:	8+ lbs. (with infill)	D1335
Primary Backing:	7 oz/sy	D418/D5848
Secondary Backing:	20 oz/sy (urethane)	D418/D5848
Avg. Grab Tear (length)	>200 lbs./force	D5034
Avg. Grab Tear (width)	>300 lbs./force	D5034
Abrasiveness Index	<25	F1015
Permeability	>40 inches/hour	DIN 18-035-6
Pill Flammability	Pass	D2859
G Max (Impact)	≤ 125 at install, ≤ 165 over life of field	F355A / F1936
Tufting Gauge	3/8"	
Stitch Rate	minimum 9 stitches per 3"	
Field Color	Field Green and Red (Clay)	
Roll Width / Length	15' wide and up to 220' long	
Infill	3.0lbs/sf ambient ground rubber / 2.0lbs/sf sand	
Drainage	3/16" holes on staggered 4" centers	

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- B. Turf Carpet: shall consist of 100% polyethylene U.V. stabilized slit film fiber and tufted into a primary backing (double layered polypropylene fabric treated with U.V. inhibitors) with a secondary backing with an application consisting of a minimum of 20 ounces of heat activated urethane per square yard to permanently lock the fiber tufts in place.
1. The Carpet shall be furnished in 15' wide rolls with four (4") inch white, football 5-yard lines tufted into each roll, when applicable. The perimeter white line shall also be tufted into the individual sideline rolls, when applicable. The rolls shall be of sufficient length to go from sideline to sidle line without splicing. Head seams, between the sidelines, will not be acceptable. All seams will be sewn (glued seams are **NOT** acceptable) and thread for sewing shall be as recommended by the Turf Manufacturer.
 2. The fiber shall be low friction, UV-resistant fiber measuring not less than 2 inches high. The same fiber from the above listed projects (Section 1.4, B.) must be used on this project.
 3. All colored inlaid lines, sport markings, numbers, and logos shall be made of the same exact blended fiber material as specified for the field carpet and shall be cut in and glued or "inlaid" as recommended by the Turf Manufacturer.
 4. Painting of Field Lines: If any lines are indicated to be painted, turf paint shall be Titan Synthetic Turf Marking Paint from Pioneer Paints, (800)-877-1500, or Architect approved equal.
- C. Field Markings: All markings to be installed in accordance with the Owner / Architect approved shop drawings, NFHS, Little League, and ASBA standards.
- Tufted Lines: Field lines to be tufted into the turf as recommended by the manufacturer.
- Inlaid Lines: Field lines to be inlaid into the turf:
- a. Baseball/Softball: White
 1. Foul lines (to end of infield except where noted)
 2. Infield / Base lines
 3. Batter's box / Coaches Box
 4. Pitcher's mound
 5. Home plates and pitching rubbers in batting cages and bull pens.
- D. Resilient infill: The resilient infill materials shall be approved by the Manufacturer. The infill shall consist of a specially formulated mixture of approximately 2.7 lbs. per square foot of crumb rubber and 3 lbs. per square foot of sand engineered to provide the look, feel, footing, and shock absorption of a natural grass field in ideal conditions.
1. Ambient ground SBR Crumb Rubber: Granules shall contain minimal dust or contaminants and shall be derived from the ambient processing form of recycled

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tires. Color shall be substantially black and shall meet the 10 – 20, 8 – 16 or 8 – 14 mesh size designation.

- a. The clean, uniformly sized particles shall be consistent in shape and particle size distribution.
- b. The particles shall resist abrasion in high traffic and excessive wear applications and provide stability to artificial sports turf applications.
- c. The particles shall be processed and sized under rigid specifications and Manufacturers' statistical and quality control assurance program.
- d. Particles shall be structurally pure and consistently uniform in size distribution for predictable performance.

2. **SBR Crumb Rubber Certification:** The Turf Contractor / Turf Manufacturer shall provide in writing that they maintain an ongoing Quality Control program meeting all the standards of the STC Guidelines for CRI Used in Synthetic Turf Fields and capable of meeting all specifications described herein.

- a. Turf Contractor shall supply the Architect with a copy of the Crumb Rubber Infill (CRI) Shipment / Order Certification that includes, type and origin of raw material (certify that it comes from tires), production facility, production method, fiber content (%), and (CRI) sieve / gradation analysis.
- b. The SBR rubber infill provided for this project shall comply with the Synthetic Turf Council's recommended testing guidelines for infill based on the EN 71-3 standard for children's toys or come from a source that maintains an active Environmental Labs (UL) Environmental Claim Validation Summary showing that the rubber produced actively meets the EN 71 standard and CPSIA standard for lead. Provide written document stipulating the above.

3. **Sand Particulate:** The sand provided as a component of the infill mixture shall be rounded so as to minimize abrasion to the athlete and synthetic grass fibers. Supplied from either Unimin or US Silica or Architect approved equal.

E. **Inlaying Materials:**

1. Adhesive for inlaying lines and markings shall be a two-component fast set urethane adhesive obtained from a single manufacturer and be equivalent to Ultrabond Turf PU 2K as manufactured by Mapei Corporation (800)-992-6273, or one-part moisture-cured polyurethane obtained from a single manufacturer and be equivalent to 34-G as manufactured by Synthetic Surfaces, Inc. (908)-233-6803 or Architect approved equal.
2. **Seaming Tape:** Tape for securing inlaid lines shall be high quality tape made with a minimum roll width of twelve inches (12”).

F. **Infield:** Field colors shall be red (clay) to match the existing turf fields onsite.

G. **Standard of Quality for Softball Infield shall be:** **Field Turf XT-50 (XT-50)** synthetic turf system as manufactured by:

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FieldTurf International, Inc.
Dalton, GA 30721
www.fieldturf.com
Contact: Chris White, (607)-729-8500

Or Architect approved equal.

2.2 PREFABRICATED POROUS SHOCK PAD

- A. Shall be minimum 8 mm thick. Porous prefabricated composite pad designed for installation under an artificial turf to add resiliency. Pad shall freely drain stormwater through the pad to gravel blanket below. Porosity rate shall be equal to or greater than porosity of turf.
- B. Acceptable standard of quality shall be a turf system shock pad as manufactured by:

ECORE International;
or other Architect approved turf manufacturer compatible shock pad.

3.0 PART 3 EXECUTION

3.1 GENERAL

- A. The installation shall be performed in full compliance with approved Shop Drawings and Submittals.
- B. Only trained technicians, skilled in the installation of outdoor athletic caliber synthetic turf systems working under the direct supervision of the Factory Certified Installation Supervisors, shall undertake any cutting, sewing, gluing, top-dressing or brushing operations.
- C. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the infill mixture.
- D. All designs, markings, layouts, and materials shall conform to all currently applicable NFHS rules and/or other rules or standard that may apply to this type of synthetic grass installation. All designs, markings and layouts must first be approved by the Architect and Owner in the form of an approved shop drawings. All markings will be installed in full compliance with those drawings.

3.2 EXAMINATION

- A. Verify that all stone drainage sub-base leveling is complete prior to installation.
- B. The surface to receive the synthetic turf shall be inspected by the Turf Contractor, and prior to the beginning of installation, the Turf Installer must accept the sub-base planarity

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in writing. The surface must be perfectly clean as installation commences and planarity shall be maintained to a surface tolerance that does not exceed 0"-1/4" over 10 feet and 0"-1/4" from design grade throughout the installation process by the Turf Contractor.

3.3 TURF INSTALLATION

- A. Install in accordance with Manufacturer's instructions. The Turf Contractor shall strictly adhere to the installation procedures outlined under this section. Any variance from these requirements must be accepted in writing, by the Manufacturer's onsite representative, and submitted to the Architect/Owner, verifying that the changes do not in any way affect the warranty or performance of the system. Infill materials shall be approved by the Manufacturer and installed in accordance with the Manufacturer's standard procedures.
- B. The carpet rolls are to be installed directly over the properly prepared stone drainage blanket and resilient pad. Rolls shall be laid out flat a minimum of four (4) hours prior to starting seaming procedures and allowed to relax / expand. Extreme care should be taken to avoid disturbing the stone blanket or pad, both in regard to compaction and planarity. Provide a 2-5 ton static roller onsite to repair and properly stabilize any disturbed areas of the stone blanket.
- C. Carefully install porous prefabricated pad on turf vendor and Architect approved stone blanket so as not to disturb planarity of the stone blanket. Install pad sections and seam together as per manufacturer's recommendations. Secure pad in place so that turf can be installed without disrupting stone blanket or shock pad.
- D. The full width rolls shall be laid out across the field. Turf shall be sufficient length to permit full cross-field installation from sideline to sideline. No "head" or cross seams will be allowed in the main playing area between sidelines. Utilizing standard state of the art sewing procedures each roll shall be attached to the next. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf.
- E. All seams shall be sewn using double bagger stitches and polyester thread (per the manufacturer's standard sewing procedures). Seams shall be flat, tight and permanent with no separation or fraying, for the life of the carpet.
- F. Infill materials shall be applied in numerous thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the Manufacturer or 1.5 inches within the fiber matrix. The mix shall be uniform and an even thickness to assure proper playing characteristics.
- G. The infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical. Specifically formulated rubber and sand infill shall be installed in accordance with manufactures system recommendations.
- H. Synthetic turf shall be attached to the perimeter edge detail in accordance with the Manufacturer's standard procedures and as detailed.
- I. Inlaid markings that are not tufted into the system shall be cut in and glued in accordance with synthetic turf contractors approved seaming methods for "inlaid" game markings.

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- J. Prior to field acceptance, the turf shall be groomed by means of a nylon rotary brush to provide the look, feel and safety of optimally maintained natural grass, including subtle undulation normally associated with natural grass athletic fields as reviewed and approved by the Architect.

3.4 CLEAN UP

- A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items to the satisfaction of the Architect / Owner.
- B. All usable remnants of new material shall be neatly rolled up and turned over to the Owner at a place and area designated by the Owner.
- C. During the contract and at intervals as directed by the Architect and as synthetic turf installation is completed, clear the site of all extraneous materials, rubbish, or debris and leave the site in a clean, safe, well draining, neat condition.
- D. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 321802

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SECTION 323001 - FLAGPOLE(S)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of new flagpole(s) is shown on the drawings.
- B. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 321301 - Site Concrete Work

1.3 JOB CONDITIONS:

- A. Job conditions in Section 312201 apply.
- B. Construction Review: Notify the Architect when flagpole footing location is coordinated to avoid underground utilities and marked in the field.

PART 2 - PRODUCTS

2.1 FLAGPOLE AND ACCESSORIES

- A. Provide one (1) twenty-five (25') foot exposed height, and two (2) thirty-five (35') foot exposed height, cone tapered, aluminum flagpole, of 6063-T6 seamless alloy, with five inch (5") butt diameter and three inch (3") top diameter dimensions. Provide standard features including: Gold anodized ball, revolving internal halyard truck assembly, nylon halyard, brass flag, snaps w/neoprene covers, beaded sling w/vinyl coated counter weight, flush access door w/cylinder lock, internal jamb cleat, spun aluminum flash collar and corrugated foundation sleeve. Finish: Duranodic anodized, #313 – Dark Bronze for pole and aluminum accessories.
- B. Provide 5' x 8' American Flag with each flagpole.
- C. Standard of quality shall be Acme Lingo Flagpoles, LLC, 1865 Route 206, Southampton, NJ 08088, Tel. (800) 260-1897, www.acmelingo.com, or Architect approved equal.

2.2 CONCRETE FOOTING: Shall be 4,500 psi as specified in Section 321301.

PART 3 - EXECUTION

3.1 INSTALL FLAGPOLE

- A. Locate as shown on drawings. Coordinate footing location to avoid utilities. Install per manufacturer's recommendations.
- B. Set pole vertical and plumb. Brace securely.

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- C. Protect flagpole installation from movement and loading until the concrete footing has attained its full design strength (approximately 28 days).
- D. Sand smooth and touch paint scrapes and scratches with compatible matching paint. Protect adjacent surfaces. Clean thoroughly when drips or spills occur.
- E. Install ball, truck, halyards and other flagpole accessories securely. Owner will provide flag.

3.2 CLEAN UP

During the contract and at intervals as directed by the Architect and as flagpole installation is completed, clear the site of gravel, concrete, appurtenances and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323001

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SECTION 323002– SITE ELEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the site elements is shown on the drawings and as specified.
- B. Site elements work includes, but is not limited to, the following:
 - 1. Providing, installing, and turning over select site elements as noted in the specifications and as detailed.
 - 2. Cleanup
- C. Provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 321301 - Site Concrete Work
- C. Section 321801 – Synthetic Turf – Multi-Purpose Turf Field
- D. Section 321802 – Synthetic Turf – Softball Infield

1.3 REFERENCES

- A. American Sports Builders Association (ASBA)
- B. National Federation of State High School Associations (NFHS)
- C. Manufacturers Data and Recommendations on Installation Requirements

1.4 SUBMITTALS: (See Section 311201, 1.5)

- A. Provide Manufacturer's Product Data (MPD) and color chips for all site items.
- B. Shade structures at bleachers: MPD, installation details, and color chart for fabric and painted posts.

1.5 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.

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PART 2 – PRODUCTS

2.1 TEAM BENCHES

- A. Permanent Team Benches: Twelve (12') feet long with backrest, heavy-duty anodized extruded aluminum with powder coated finish (color selected by Architect). Galvanized steel frame with surface anchor mounted system. Seat and backrest shall have aluminum caps at ends and meet ANSI 903 compliance for accessibility.
- B. Standard of Quality:
Model No. BE-PB12 with back as manufactured by National Recreation Systems, Inc., 312-280-3805, distributed by Baugham Brothers, Inc., Baldwinsville, NY 800-365-4930 or 315-638-4387. Or Architect approved equal.
- C. Provide four (4) at Field No. 3.
Provide sixteen (16) at Multi-Purpose Turf Field.

2.2 PICNIC TABLES (PROVIDE 8)

- A. TenderTuff-coated Square Picnic Tables With 4 Seats, TenderTuff-coated Steel, Movable as manufactured by Landscape Structures, Inc., 1-800-328-0035 or Architect approved equal.
- B. Table Leg: Weldment comprised of 2.375" O.D. x RS40 (.130"-.140" wall) galvanized steel tubing, 3/16" x 2" HR flat steel, 3" x 2" x 3/16" HR steel angle, 1/8" x 1 1/2" HR flat steel and 1/4" x 1/2" stainless flat steel. Finish: powdercoat, color specified
- C. Table Top: Weldment comprised of 12 GA (.105") sheet HRPO steel, table top measures 42" square with 5/16" diameter holes on surface. Finish: TenderTuff, color specified.
- D. Seat: Weldment comprised of 12 GA (.105") sheet HRPO steel, seat plank measures 10" wide x 32" long with 5/16" diameter holes on surface. Finish: TenderTuff, color specified.
- E. Fasteners: Primary fasteners shall be socketed and pinned tamperproof in design, stainless steel (SST) per ASTM F 879 unless otherwise indicated (see specific product installation/specifications).
- F. Within number of benches required, provide minimum amount +1 of wheelchair accessible tables. Verify with manufacturer prior to ordering and submitting product data.

2.3 TRASH RECEPTACLES

- A. Trash Receptacle: Pitch litter receptacle with standard tapered farmed lid with black polyethylene liner, for surface mounting. Finish: Powder coated black. Provide ten (10). Standard of quality shall be ES-235 with recycle lids as manufactured by Victor Stanley or Architect approved equal.

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2.4 FOUL POLE(S) AT SOFTBALL FIELD NO. 3

- A. Shall be poles with 15' exposed height, 4" OD x 1/8" wall aluminum upright with yellow powder coated finish, 30" ground sleeves, 7' long aluminum wings with double reinforced bends. Standard of quality shall be model FPW415 as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. Provide one (1) pair at Softball Field No. 3

2.5 FOUL POLE(S) AT MULTI-PURPOSE FIELD - BASEBALL

- A. Shall be poles with 30' exposed height, 6-5/8" OD x 1/8" wall aluminum upright with yellow powder coated finish, 48" ground sleeves, 22' long aluminum wings with double reinforced bends. Standard of quality shall be model FPW630 as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. Provide two (2) pair for the Baseball Fields at the Multi-Purpose Turf Field.

2.6 FOUL POLE(S) AT MULTI-PURPOSE FIELD - SOFTBALL

- A. Shall be poles with 15' exposed height, 4" OD x 1/8" wall aluminum upright with yellow powder coated finish, 30" ground sleeves, 7' long aluminum wings with double reinforced bends. Standard of quality shall be model FPW415 as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. Sleeve Access Frame Kit: Access Frame Kit: 1/8" (0.125") Aluminum Construction with 1" PVC Drain Stub, Includes Two (2) Half Moon Filler Plugs and SG2SGPR30 for Synthetic Turf Installation Applications. Required is Full Size Filler Plugs wrapped in synthetic turf for when foul poles are not in place.
- C. Provide two (2) pair / complete systems for the Softball Fields at the Multi-Purpose Turf Field.

2.7 SHADE STRUCTURES AT BLEACHERS- (PROVIDE 10)

- A. Shall be a freestanding shade structure utilizing two main support posts and a T-cantilevered fabric shade structure canopy, 10'-0" high x 12" deep x 24'-0" wide. Steel frame with powder coated finish (color as selected by the Owner). Hardware is 316 stainless steel. Shade fabric shall be knitted monofilament and polyethylene canopy fabric ASTM E-84 with a manufacturer's UV warranty of 10 years (color as selected by the Owner). Turn and slide fastening system shall be standard. Product shall be T-cantilevers by Shade Systems, Inc., 800-609-6066 www.shadesystemsinc.com or Architect approved equal.

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2.8 COMBINATION FOOTBALL/ROUND FACED SOCCER SYSTEM

- A. Basis of design and standard of quality shall be GPKR20ADJRGH Adjustable High School Rotating and Gooseneck Hinged GoalPak as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- B. Provide two (2) pair of football and soccer goals at multi-purpose turf field.
- C. Components:
 - 1. Rotating High School Football Goal Posts:
 - A. Rotating Base Plate Mounting Kit
 - 1. Two Piece Hydraulically Hinged Gooseneck Support Consisting of the Following Components:
 - a. Upper and Lower Gooseneck Fabricated of 6" Schedule 40 Aluminum Pipe (6.625" O.D.) with the Upper Gooseneck Rolled to a 3' Radius and 8' Offset
 - b. 3/4" Aluminum Mounting Plates with 3/4" Aluminum Gussets
 - c. 3/4" A572 Steel Hinge Plates with a Black Powder Coated Finish
 - d. 1/2" Dia. Grade 8 Zinc Yellow-Chromate Plated Steel Pivot Pin
 - e. Hydraulic Cylinder, 2.50" Bore x 1.25" Rod, 12" Stroke, 3000 PSI
 - f. 1/2" Dia. x 3.50" Long 17-4 Stainless Steel Locking Pull Pin, Includes Padlock
 - 2. Removable Hydraulic Compartment: Fabricated of 0.125" Aluminum Sheet with Removable 0.125" Aluminum Cover with Handle. Consists of the Following Components:
 - a. 4.25 Cup Capacity Hydraulic Fluid Tank Fabricated of 0.125" Aluminum Sheet with Plastic Vented Cap
 - b. 0.097 in³, 4000 PSI Hydraulic Gear Pump for Raising Goal
 - c. 3-Way Directional Control Valve with Adjustable Relief Valve for Lowering Goal, 3000 PSI Max
 - d. Adjustable Flow Control Valve, 5000 PSI Max
 - e. 3/8" I.D. Hydraulic Hose with Quick Disconnect Coupling, 4000 PSI Max
 - f. Assorted Steel and Stainless Steel Fittings, Couplers, and Mounting Hardware
 - g. 4.00 Cups of AW-46 Hydraulic Fluid
 - 3. Crossbar: Fabricated of 6" Schedule 40 Aluminum Pipe (6.625" O.D.)
 - a. Length: Adjustable from 18'-6" to 23'-4" (College/High School)
 - b. Includes Patented AdjustRight® feature allowing for easy installation through the adjustment of an internal locking rotating sleeve at both the gooseneck/crossbar and upright/crossbar connections. This adjustment can

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easily be repeated throughout the life of the football goal post ensuring proper alignment of all components for years of competition and all with the added benefit of no exposed hardware on the face of the goal. Thermal arc sprayed internal textured mating surfaces and anti-vibration enhancements such as serrated washers and nyloc coated bolt ends ensure the AdjustRight® Football Goal Posts remain in position.

4. Uprights: Fabricated of Extruded 6061-T6 Aluminum Tube (4" O.D.) with Rigid Wire Loop Welded to Upper End
 - a. Length: 20'
5. Super Durable Powder Coated Finish with Enhanced Resistance to UV and Fade
 - a. Color: Yellow or White
6. Installation Package Consisting of the Following Components:
 - a. Rotating Base Plate Mounting Kit
 - b. Access Frame Kit: 1/8" (0.125") Aluminum Construction with 1" PVC Drain Stub, Includes Two (2) Half Moon Filler Plugs and SG2S® Patented Soccer Goal Rear Bottom Ground Bar Retractable Safety Clamp System, Use SG2SGPR30 for Synthetic Turf Installation Applications. Required is Full Size Filler Plugs wrapped in synthetic turf.
7. Included Accessories:
 - a. Directional Wind Flags
 - b. Touch-up Paint (Powder Coat Finish Specific)
 - c. Model Specific Hardware Kit and Installation Instructions

B. SG824R Round Post Soccer Goal(s):

- a. Cross Bar: #4950-TOPCROSSBAR Fabricated of 6061 T6 extruded aluminum tube, 4.375" x 4.688", having the following attributes:
 1. Length: 24' (inside of upright to inside of upright)
 2. Round face with radiused backside corners
 3. 7 gauge powder coated steel crossbar attachment brackets
 4. Powder coated white
- b. End Frame: #4950-ENDFRAME fabricated of 6061 extruded aluminum tube having the following attributes:
 1. Upright posts, 4.375" x 4.688", round face with radiused backside corners
 2. Rolled side frame, 2" x 3" x .1/8" wall thickness, tig welded to upright posts
 3. Powder coated white
- c. Ground Bar: #4950-BOTTOMGROUNDBAR fabricated of 6061 T6 extruded aluminum tube, 2" square x .1/4" wall thickness, having the following attributes:
 1. Powder coated white
- d. Accessories:

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1. Welded aluminum net clips, guaranteed for life
 2. Soccer Net: 5mm braided polyethylene, 4" square mesh, white
 3. Stainless steel assembly hardware
3. SGMKR SGMobile - Soccer Goal Portable Wheel Mobility Kit:
- a. Soccer Goal Wheel Insert
 1. Welded 13 gauge stainless steel frame
 2. UHMW plastic wheel
 3. Stainless steel hardware
 - b. Soccer Goal Mobility Handle
 1. Formed 3/8" stainless steel round stock
 2. Stainless steel hardware
 3. Powder coated white.
4. SG2SGPR30 - Soccer Goal Back Bar Safety Clamp Kit:
- a. #SG2S-GP Safety Clamp
 1. Fabricated of 1/4" aluminum
 2. Powder coated white
 3. Quick release hardware
 4. For use with Access Kit
5. SGWKL – Levered Soccer Goal External Wheel Kit:
- a. Levered External Wheel Kit for Soccer Goals
6. Concrete shall be 4,500 psi as described in Section 321301.

2.9 FOOTBALL GOAL POST PADS

- A. Fully Encased Vinyl Covering: 19 oz Vinyl - 19 Oz Polyester Scrim Coated Vinyl, Grab Tensile; 450 x 450 lbs./in, Tongue Tear: 84 x 85 Lbs. Vinyl cover is stitched using polyester thread, color: Black. Covering Color: Provide color chart for Owner review.
- B. Filler Foam: 18" Outside diameter polyurethane foam core - Density (PCF): 1.3 +/- .05., Indention load deflection: 40 U 48 lbs. at 25% compression, Tear Strength: 1.5-2.5 lbs./inch.
- C. Attachment: Center of polyurethane foam core is cutout to fit specific pole diameter (up to 6") - Velcro attachments sewn the entire 6" height of the pad to secure the core.
 1. Custom lettering as directed by Owner. Lettering color shall be selected by owner. Provide color chart.
 2. Provide two (2) pair with Multi-Purpose Turf Field.
- D. Standard of quality shall be Model GPPRGHDG Round as manufactured by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.

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2.10 LACROSSE GOALS

- A. Goals: Shall be heavy duty 1.9” inch powder coated steel pipe posts and cross bar, 4” flat base bar, 2 piece construction. Standard of quality shall be Professional Game Goal as manufactured by Brine or Architect approved equal.
- B. Provide two (2) pair of goals.
- C. Nets shall be 4.0mm high extension polyester lacrosse net, 6’ x 6’ x 7’ official size. Color as selected by the owner. Triple stitched bindings with quick fasteners and lacing cord. Standard of quality shall be Championship Lacrosse Net as manufactured by Brine or Architect approved equal.

2.11 CORNER FLAGS

- A. Shall be a hollow plastic base, 1” diameter PVC upright, with red triangular flag; Overall height of 60”. Hollow base to be weighted with sand on site. Provide two (2) sets of four (4).
- B. Basis of design and standard of quality shall be model SG6B1104 as distributed by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- C. Provide eight (8) with Multi-Purpose Turf Field

2.12 DOUBLE BASEBALL TENSION BATTING TUNNEL – (PROVIDE 2) - ALTERNATE

- A. Base: BTTBD – Tension Baseball Double Batting Tunnel; as Manufactured and Supplied by:
 - Sportsfield Specialties, Inc.
 - P.O. Box 231
 - 41155 State Highway 10
 - Delhi, NY 13753
 - p. 888-975-3343
 - www.sportsfieldspecialties.com Or Architect approved equal.
- B. Components:
 - 1. Six (6) Upright Poles Fabricated of 8” Schedule 40 Steel (8.625” O.D.) Pipe
 - 2. Fixed Net Stabilizer Extension Arms Fabricated of 3/8” Steel Plate
 - 3. Crossbar Supports Fabricated of 4” x 3/16” Wall Square Steel Tube
 - 4. Durable Black Powder Coated Finish
 - 5. Tension Cable Support: ¼” 7x19 Black Powder Coated Galvanized Aircraft Cable with ½” x 6” Jaw and Jaw Turnbuckles
 - 6. Two (2) 13’ H x 14’W x 75’ L Baseball Net
 - a. #36 Black Nylon 1-3/4” square mesh net
 - 1. #36 twisted knotted netting
 - 2. 100% nylon construction
 - 3. 2.6mm (0.1023”) diameter twine
 - 4. 87% open mesh area

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5. 13,363 psi minimum breaking strength
6. 1-3/4" (44mm) maximum square mesh size
7. 0.0425 lbs per square foot
8. Black multi-filament polypropylene solid braid derby rope sewn binding on perimeter edges – 1/4" diameter, 530 lb. minimum breaking strength
9. UV and weather treated
- b. Four (4) 4' W x full height openings with curtain style exterior overlap flaps
- c. Weighted rope bottoms factory sewn/integrated into batting tunnel
 1. 2,000 lbs. average strength
 2. 250 lbs. per 100 fathoms material weight
7. Model Specific Hardware Kit and Installation Instructions

2.13 PORTABLE OUTFIELD FENCING - ALTERNATE

- A. Provide 1,400' linear feet of portable outfield fencing.
- B. Shall be a portable fencing system with retractable wheels, vinyl coated colored chain link fence fabric, and yellow plastic fence topper.
- C. Each fence panel is 5'-0" tall and 10'-0" long. The frame is 1-5/8" galvanized steel pipe with 8-gauge vinyl coated black chain link fencing.
- D. Each panel has a rear frame that includes 2" wide x 6" tall solid rubber wheels for easy transport.
- E. Standard of Quality shall be Model 5'X10' Premium Wheeled Panel Fencing as manufactured by SportaFence and as distributed by SportaFence www.sportafence.com or Architect approved equal.

PART 3 – EXECUTION

3.1 INSTALL BENCHES

- A. Locate as shown on drawings or as directed by the Architect.
- B. Sand smooth and touch paint with compatible color matching paint scraped and rough areas. Protect adjacent surfaces. Clean thoroughly when drips and spills occur.
- C. Benches the chip or lose powder coating color within the first two years after installation will need to be corrected by the Contractor at no additional cost to the Owner.

3.2 INSTALL TRASH RECEPTACLES

- A. Locate as directed by the Architect.
- B. Install as directed by the manufacturer.

3.3 PICNIC TABLES AND SHADE STRUCTURES

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- A. Assemble as recommended by the manufacturer and place on site as directed by the Architect.

3.4 FOUL POLE(S)

- A. Install as directed by the manufacturer and as detailed.

3.5 FOOTBALL/SOCCER GOALS/FOOTBALL PADS

- A. Assemble and install per manufacturer's instructions in location as directed.

3.6 LACROSSE GOALS

- A. Assemble and turn over to Owner.

3.7 CORNER FLAGS

- A. Turn over to Owner.

3.8 BATTING TUNNELS

- A. Install as recommended by the manufacturer and as detailed

3.9 PORTABLE OUTFIELD FENCING

- A. Assemble and erect onsite. Verify proper layout and installation with Owner.
- B. After Owner approval, stockpile in a location as directed by the Owner.

3.10 CLEAN UP

During the contract and at intervals as directed by the Architect and as bench installation is completed, clear the site of extraneous packaging materials, concrete, gravel, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323002

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SECTION 323003 - INFIELD WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Infield work includes, but is not limited to, the following:
 - 1. Subgrade Preparation
 - 2. Coarse Sand and Aggregate Layer
 - 3. Warning Track Clay Mix
 - 4. Pitcher's Rubber, Home Plate and Bases - Synthetic Turf
 - 5. Portable Pitcher's Mound(s)
- B. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 323100 - Vinyl Clad Chain Link Fence, Backstops, and Gates
- C. Section 321801 – Synthetic Turf – Multi-Purpose Turf Field
- D. Section 321802 – Synthetic Turf – Softball Infield

1.3 SUBMITTALS:

Provide material certificates showing content/mechanical analysis, Manufacturer's Product Data (MPD), and samples required as follows:

- 1. Coarse Sand: Material certificate and six (6 oz.) ounce sample
- 2. Warning Track Clay Mix: MPD, Material certificate and six (6 oz.) ounce sample
- 3. Pitcher's Rubber, Home Plate, and Bases (Synthetic Turf): MPD
- 4. Portable Pitcher's Mounds: MPD

1.4 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. Notify the Architect when each major component is near completion for review prior to proceeding to next operation.

1.5 QUALITY ASSURANCE

- A. Provide a field representative to coordinate and review the component parts of the infield work.

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- B. Proof roll subgrade with small (2-3 ton) residential scale roller to provide a smooth, evenly compacted surface.
- C. Use landscaping edging with stakes as a temporary divider prior to installing lawn and sand/infield mix. Edging provides a neat line to place all materials against.
- D. Install coarse sand, imported granular backfill, and warning track mix in carefully measured layers.
- F. The finish surface shall have no depressions or ridges exceeding one-eighth (1/8") inch in ten (10') feet. Also, no small ponds or bird baths larger than three (3 s.f.) square feet are acceptable. Make all necessary corrections as directed by the Architect.
- G. The Contractor shall maintain the warning track mix free of weeds until final acceptance by the Owner.

PART 2 - PRODUCTS

2.1 COARSE SAND

Shall be clean, coarse concrete sand, graded as follows:

<u>Standard ASTM Sieve Size</u>	<u>Percent Passing By Weight</u>
Passing 3/8"	100
Passing No. 4	75 - 90
Passing No. 16	30 - 45
Passing No. 50	5 - 10
Passing No. 100	2 - 5

2.2 WARNING TRACK BLEND

A. This red clay product is design to provide the following characteristics:

- 1. Orange-red color
- 2. Good water retention
- 3. Soft texture
- 4. Safety enhancing texture
- 5. High drainage

B. Particle size analysis:

Sand: 90-95%
Silt: 1-3%
Clay: 2-5%

C. Sieve Analysis:

<u>Sieve # and Size</u>	<u>Percent Passing</u>
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#4 (4.76mm or 3/16")	90-95%
#7 (2.83mm or 1/8")	30-40%
#20 (0.84mm)	25-35%
#60 (.25mm)	10-20%
#100 (.105mm)	5-15%
#200 (.075mm)	0-10%

- D. Weight: Clay Track Surfacers weigh approximately 2200 pounds per cubic yard.
- E. Standard of quality shall be Clay Track Surfacers 20 as manufactured by Mar-Co Clay Products, Inc., www.marcoclay.com or as distributed by Northern Nurseries, Cicero, NY, (315) 699-3999 or Architect approved equal.

2.3 PITCHER'S RUBBER, HOME PLATE AND BASES

- A. Pitcher's Rubber: Shall be moveable, 6" x 24" white rubber high-durability, molded rubber construction with dual stanchion aluminum tube inserts. Standard of Quality shall be Item SHLBMPR224 Hollywood Dual Stanchion Pitching Rubber as manufactured by Schutt Sports and supplied by Sportsfield Specialties, Inc., 888-975-3343 or Architect approved equal. Provide nineteen (19) total.
- B. Home Plate Forming System: Model No. HPFS as manufactured and supplied by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
 - 1. Home Plate Forming System: Provide five (5) sets.
 - a. Measures 2'-8" L x 2" -8" W x 5"H
 - b. Welded Construction, fabricated of aluminum sheet with one (1)- $\frac{1}{2}$ " schedule 40 aluminum drainage pipe and five (5) $\frac{3}{4}$ " aluminum round stock threaded studs with $\frac{3}{8}$ " stainless steel bolts for home plate tray height adjustment.
 - c. Removable and height adjustable home plate tray.
 - d. Includes replaceable SHSRHP Schutt Hollywood Bury All Home Plate or Architect approved equal.
 - e. Includes Synthetic Infill Turf Attachment Ledge
 - f. HPFSCP Removeable Cover Plug: $\frac{1}{8}$ " (0.125") aluminum sheet with 1.5" square aluminum support structure, synthetic turf provided by and installed by Turf Installer.
- C. Standard Bases: Shall be natural rubber cover over foam core, 15" x 15" x 3", set of 3 bases with anchors, 6" base stanchions. Standard of Quality shall be Schutt Hollywood Impact Double First Base Set (Softball) and Schutt Hollywood Impact Base Set (Baseball) as manufactured by Schutt Sports or Architect approved equal. Provide five (5) sets of bases.
- D. Little League Bases: Shall be natural rubber cover over foam core, 15" x 15" x 2 $\frac{1}{4}$ ", set of 3 bases, 6" base stanchions. Bases shall be Little League Rule 1.06 compliant and shall have Youth Resistance of 19 lbs of pressure. Standard of Quality shall be Schutt Hollywood Impact Kwik-Release Double First Base Set (Softball) and Hollywood Impact Kwik-Release Base Set (Baseball) as manufactured by Schutt Sports or Architect approved equal. Provide five (5) sets of bases.

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- E. Ground Anchors: 8” Female Ground anchors, 1-3/4” square. Model No. SHBBP-44 Ground Anchor Mounts as manufactured by Sportsfield Specialties or Architect approved equal. Provide eleven (11) sets of (3) ground anchors for the bases, mounts and twenty-four (24) sets to support dual stanchion support tubes at softball first base and pitching rubbers.
- F. Turf Base and Pitching Rubber Set: Shall be all rubber construction with mesh reinforcement and pegs molded to the underside that grip turf and infill material to prevent lateral movement. Provide set of 3 bases and pitching rubbers. Standard of quality shall be TB (set of 3) and TBPR as distributed by Sportsfield Specialties, Inc., 888-975-3343 or Architect approved equal. Provide five (5) sets.
- G. Anchor Access Frame: Model No.: SHAFIT as manufactured and supplied by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
 - 1. Schutt/Hollywood Anchor Access Frame for Infill Turf: Provide thirty-one (31).
 - a. Dimensions: 8-1/16"W x 8-1/16"L x 10"H
 - b. Box: 1/8" (0.125") aluminum construction, welded frame with open bottom having the following attributes:
 - i. 1/8" (0.125") aluminum construction
 - ii. Integrated synthetic infill turf attachment ledge
 - iii. Infill retainer system with 1-1/4" (1.25") flexible gasket seals specifically designed for synthetic infill turf applications
 - iv. Anchor base, anchor bolts and anchor spacer
 - v. 1" PVC drain stub for positive drainage connection
 - c. Solid Cover: 1/8" (0.125") aluminum construction with the following attributes:
 - i. Infill retainer system with 1-1/4" (1.25") flexible gasket seals specifically designed for synthetic infill turf applications
 - ii. Adhere synthetic turf material directly to the aluminum surface with appropriate adhesive and/or mechanical fasteners as determined by the Turf Installer
 - d. Assembly Hardware
- H. Dual Anchor Access Frame: Model No.: SHAFPRIT as manufactured and supplied by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
 - 1. Schutt/Hollywood Dual Anchor Access Frame for Infill Turf: Provide twenty-four (24).
 - a. Dimensions: 6-1/16"W x 22-15/16"L x 10"H
 - b. Box: 1/8" (0.125") aluminum construction, welded frame with open bottom having the following attributes:
 - i. 1/8" (0.125") aluminum construction
 - ii. Integrated synthetic infill turf attachment ledge
 - iii. Infill retainer system with 1-1/4" (1.25") flexible gasket seals specifically designed for synthetic infill turf applications
 - iv. Anchor base, anchor bolts and anchor spacer
 - v. 1" PVC drain stub for positive drainage connection

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- c. Solid Cover: 1/8" (0.125") aluminum construction with the following attributes:
 - i. Infill retainer system with 1-1/4" (1.25") flexible gasket seals specifically designed for synthetic infill turf applications
 - ii. Adhere synthetic turf material directly to the aluminum surface with appropriate adhesive and/or mechanical fasteners as determined by the Turf Installer
- d. Assembly Hardware

2.4 PORTABLE PITCHER’S MOUND(S) – LITTLE LEAGUE

- A. Shall be an Official Little League Approved Game Mound covered with red (clay) synthetic turf matching infield turf exactly. 6” high, 6’-10” wide, 9’-2” long, approx. 180 lbs.
- B. Standard of quality shall be “Little League Game Mounds” as provided by True Pitch, Inc., 800-647-3539, www.truepitchmounds.com or Architect approved equal.
- C. Provide two (2) with for Field No. 3 and Provide eight (8) with Multi-Purpose Turf Field.

2.5 PORTABLE PITCHER’S MOUND(S) – HIGH SCHOOL

- A. Shall be an Official NFHS Approved Portable Game Mound covered with red (clay) synthetic turf matching infield turf exactly. 10” high, with interlocking connection tabs and 10' L x 5' W transport cart.
- B. Standard of quality shall be LGPRTPTCH-RC-SYN and MC510 CART as manufactured by Sportsfield Specialites, 888-975-3343, www.sportsfieldspecialties.com or Architect approved equal.
- C. Provide two (2) portable mounds and one (1) cart with Multi-Purpose Turf Field.

PART 3 - EXECUTION

3.1 FIELD LAYOUT: Per Section 312201, 1.6, C.

3.2 SUBGRADE PREPARATION

- A. Grade subgrade parallel to the finish grade.

3.3 TEMPORARY EDGING

Provide landscape edging with stakes as a temporary divider prior to installing lawn and sand/infield mix has stabilized. Carefully remove when lawn and sand/infield mix has stabilized.

3.4 COARSE SAND

Place and compact layer of sand on the prepared subgrade. Thickness of layer depends on location. Refer to table below and drawing details. Work lightly to achieve optimum density.

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3.5 INSTALL WARNING TRACK MIX

- A. Place in 1-1/2" layers at a time, wetting and compacting each layer. Total depth varies depending on location. Refer to drawings.

3.6 DRAG SURFACE

- A. Fine grade infield surfaces with rigid baseball diamond drag mats and hand tools until surfaces meet smoothness requirements below.
- B. Surface Smoothness: Provide smooth, even draining surface, meeting the following requirements:
 - 1. At perimeter where skinned infield mix abuts turf / grass, the grades shall be flush and even.
 - 2. Internally, warning track mix areas shall be acceptable when surfaces are tested with a ten (10') straight edge or taught string line and surface variations are less than 1/8".

3.7 PITCHER'S RUBBER, HOME PLATE, AND BASES

- A. Install in areas as shown on the plans and detailed per manufacturer's recommendations. Review layout with Architect prior to installation.

3.8 PORTABLE PITCHER'S MOUNDS

- A. Install in areas as shown on the plans and detailed per manufacturer's recommendations. Review layout with Architect prior to installation.

3.9 CLEAN UP

During the contract and at intervals as directed by the Architect and as baseball infield work is completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323003

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SECTION 323004 - PORTABLE ALUMINUM BLEACHERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The bleacher locations are shown on the drawings.
- B. Provide materials, labor, equipment, and services required to deliver and assemble related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 321201 - Asphalt Paving

1.3 SUBMITTALS: (See Section 311201, 1.5)

Provide Manufacturer's Product Data (MPD).

1.4 QUALITY ASSURANCE

- A. Applicable Codes and Standards: NFPA 102, 1992 or latest edition. AISC manual, 9th Edition, 1990. Aluminum Association of America, NYS Building Code 2007 or latest edition.
- B. Manufacturer Qualifications: Manufacturer must have ten years experience in the manufacture of bleachers; welders must be AWS certified.
- C. Source Quality Control: Mill Test Certification

1.5 JOB CONDITIONS

- A. Job conditions in Section 312201 and 321201 apply.
- B. Warranty shall guarantee bleachers to be free from defect in materials and workmanship for a period of 1 year under normal use. Warranty period shall begin on date of completion for projects installed by manufacturer, or its subcontractors, OR warranty period shall begin on date of final delivery installed by others.
- C. Construction Review: Notify the Architect when the bleacher anchor locations are coordinated to avoid underground utilities and the bleacher location(s) are staked out in the field and ready for review.
- D. Plank extrusions shall be covered by a five year warranty against loss of structure strength or finish deterioration and discoloration specifically to exposure to varying weather conditions or ultra-violet rays. Damage resulting from abnormal use, vandalism or improper installation will render warranties above null and void.

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2.0 PART 2 - PRODUCTS

2.1 BLEACHERS: Shall be transportable, non-elevated, heavy duty aluminum bleachers.

A. Production Description:

1. Rise and Depth Dimensions: 3 row units: 6" x 24", seat is 16" above its respective tread.
2. Framework: Prefabricated aluminum square tube bleacher frames are spaced at 6' intervals and jointed by angle cross-braces.
3. Seats: Nominal 2" x 10" clear anodized (AA-M10C22A31) aluminum plank with 2" x 10" end caps.
4. Treads: Nominal 2" x 10" mill finish aluminum plan ends caps.
5. Risers:
 - a. 1" x 6" (or 2" x 4" for 3 row models) mill finish aluminum plank for all applicable rows except top row.
 - b. Top row riser to be (2) 1" x 6" mill finish aluminum. Riser planks beginning under seat row 4 when aisles are not included, or under seat row 1 for non-elevated with aisles and for all elevated bleachers.
6. Joint Sleeve Assembly: Internal splices, where required shall be two per joint, and shall penetrate the joint a minimum of 8" in each direction and be riveted at one end only to allow for contraction and expansion.
7. Aisles: Aisle footboards shall be of aluminum alloy 6063-T6 and be mill finish with contrasting aisle markings. Three aisle stiffener angles shall be used to strengthen the aisle step. All rails shall be secured to angle supports with galvanized fasteners. Top rails at sides and rear.
8. Transport: The unit shall be divisible in 5-row x 21'-0" maximum increments, include all extra bracing and hardware to make unit transportable, and be able to accept the following Transport Kit (wheel and tongue assembly):
 - a. Transport Kit HD: Consists of 3 wheel assemblies and one 1-7/8" ball hitch with 10" tongue and internal hydraulic jacks. Tires to be P205-75-R14, steel belted radials, load capacity 1620# at 32 psi per tire.
9. Ground Sills: Shall be a minimum of 2" x 6" nominal lumber, pressure treated to render resistant to the elements (treated with ACQ per AWWPA Standards).

B. Materials/Finishes:

1. Framework:
 - a. Aluminum: Structural fabrication with aluminum alloy 6061-T6, or mechanically equivalent mill finish. Each frame shall be unit-welded,

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using metal inert gas method, under guidelines by the American Welding Society. After fabrication all steel is hot dipped galvanized to ASTM A-123 specifications. All crossbracing and horizontal bracing shall be aluminum angle 6061-T6 mill finish.

2. Extruded Aluminum:
 - a. Seat Planks: Extruded aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II with a wall thickness nominally .078" for impact and deformation resistance.
 - b. Tread Planks, Riser Planks: Extruded aluminum alloy 6063-T6, mill finish with a wall thickness nominally .078" for impact and deformation resistance.
 - c. Joint Sleeve Assembly: Extruded aluminum alloy 6061-T6, mill finish.
3. Accessories:
 - a. Channel End Caps: Aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II.
 - b. Hardware: Bolts, nuts, hot dipped galvanized.
 - c. Hold-Down Clip Assembly: Aluminum alloy 6063-T6, mill finish.
 - d. Guardrail: Aluminum Pipe: 1.66 O.D., schedule 40, Aluminum alloy 6105-T5, clear anodized 204R1, AA-M10C22A31, Class II.

C. Fabrication:

1. Design Loads:
 - a. Uniform Load Structure: 100 psf.
 - b. Uniform Load Seat and Tread Plank: 120 plf.
 - c. Lateral Sway Load: 24 plf seat plank.
 - d. Perpendicular Sway Load: 10 plf seat plank.
 - e. Guardrail: Uniform Horizontal Load: 50 plf.
Uniform Vertical Load: 100 plf.
Concentrated Horizontal Load: 200 lbs.

- D. Standard of Quality shall be portable aluminum bleachers as manufactured by National Recreation Systems, Inc., 888-568-9064, E&D Specialties (800)-525-8515, or Architect approve equal. Provide the following model(s) with heavy duty travel 3-wheel kit to move the section in one operation:

Model NB-0324APRF 3 rows x 24' length 48 net seats: Provide ten (10) sets

PART 3 - EXECUTION

3.1 INSTALL BLEACHERS

- A. Install per manufacturer's recommendations as detailed.

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- B. Check connections. Make connections tight and secure. Peen ends of bolts or score threads to prevent removal of nuts by vandals.
- C. Smooth uneven or rough edges and connectors exposed to human touch.

3.2 CLEAN UP

During the contract and at intervals as directed by the Architect and as bleacher installation is completed, clear the site of extraneous equipment, packaging materials, equipment, concrete, gravel, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323004

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SECTION 323005 - ELEVATED ALUMINUM BLEACHERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the semi-closed deck elevated fixed bleachers are shown on the drawings. Make all transition connections smooth and in a neat workmanlike condition.
- B. Approximately 375 seat fixed elevated angle frame bleachers include, but are not limited to, the following:
 - 1. Concrete pad and footings
 - 2. Structural aluminum framing
 - 3. Aluminum seats, semi-closed deck and guardrail fencing, stairs, and handicap ramp
 - 4. Double foot planks for all rows
 - 5. Cleanup
- C. Access for bleachers shall be by means of stairs and ramp meeting pavement as shown on drawings.
- D. Provide all materials, labor, equipment and services required to accomplish all related work in accordance with the drawings and specifications. Provide all design, engineering, freight, installation, supervision, state approvals, and inspections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 321201 - Asphalt Paving
- C. Section 321301 - Site Concrete Work

1.3 SUBMITTALS/APPROVALS

- A. **Materials Certificates:** Provide copies for each material from material producer, stamped as checked and approved by the Contractor before submittal to the Architect. Each material shall be certified by an approved independent testing laboratory as complying with or exceeding the specified requirements. Submit certificates to Architect a minimum of two (2) weeks prior to installation for 4,500 psi concrete.
- B. **Design Calculations:** Design calculations shall be submitted for review by the Architect. The calculations shall bear the seal and signature of a licensed New York State Professional Engineer and shall present an analysis that will indicate the structural members are of sufficient strength to support the design loads. This analysis shall also indicate that the structural members are able to resist deformations caused by such design loads to which they may be subjected, without exceeding the allowable stresses of the materials. Grandstands shall be in accordance with the New York State Labor and

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Industry, Title 34, Chapter 15- Grandstands. All fees for review and inspection shall be paid by the contractor.

- C. Shop drawings shall include all specified products, seating plan, aisles, walkways, seating sections and exits. Provide end elevations indicating rise and row depth, deck configuration and method of attachment, railings, size of framing members, vertical aisle details, and walkways.
- D. Samples:
 - Seatboard
 - Footboard
 - Riserboard
 - Handrail support post and cap
 - 12" x 12" chain link
 - Deck attachment support member
 - Intermediate step
 - Seating mounting bracket - "L" type to meet BOCA and NFPA codes
- E. Seating plan indicating aisles, walkways, seating sections, and exits.
- F. Schedule of work experience, including names and telephone numbers of contacts; 10 people minimum equal value.
- G. List of three similar jobs - should the Owners (three persons maximum) request a site visitation to these jobs, it will be at the bidders expense.
- H. Resume including Corporate Officers, Sales Representatives, Technical Advisor, Project Manager, and Job Site Superintendent.
- I. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: All design, fabrication and construction shall comply with the requirements of NFPA 101 and 102, NYCRR, and Americans with Disabilities Act, and International Building Codes/ICC 300 2017, whichever is more stringent. Current edition shall govern.
- B. Bidding: Contractor shall bid bleachers as detailed and specified. If modifications are required by regulatory agencies, changes will be incorporated into the contract at no additional cost to the Owner. Welders must conform to AWS Standards and local code requirements.
- C. For fabrication of the bleachers, use only personnel who are thoroughly trained and experienced in the fabrication of grandstands and bleachers. Seating shall be designed to meet or exceed specified fire and safety codes. Provide Product Liability Certificate of Insurance coverage for life of product.

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- D. List minimum of three (3) similar jobs for the Architect or Owner to review prior to accepting the suppliers bid proposal. Manufacturers must have a minimum of 10 years experience in the design and manufacturing of bleachers.
- E. Provide test reports certifying that the bleachers have been inspected and installed in accordance with the contract documents. This shall be performed by an independent testing agency hired by the contractor. The testing agency's representative shall be either a NYS licensed Professional Engineer or working under the direct supervision of a NYS licensed Professional Engineer. The inspection shall include examination of:
 - 1. High strength bolted connections for general conformance with the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts". The connections shall be examined to confirm a "snug tight" condition with all plies in intimate contact.
 - 2. General conformance with the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" to confirm that all nuts are "run down".
 - 3. Confirmation of non-slip finish installation.

1.5 JOB CONDITIONS

- A. All job conditions in Section 311201 apply.
- B. Verify site location of bleachers and locate all underground utilities. Visit site as described in Section 311201.
- C. NY State Professional Engineer (PE) hired by the bleachers' supplier will determine soil bearing capacity of on site soils from provided soil boring, pit information, and additional testing as the PE deems necessary. The PE is solely responsible for design interpretations and subsequent design of the bleachers.
- D. The contract documents provided by the Owner include existing and proposed grades.
- E. The contract documents indicate grades, approximate pier locations and walkways to meet the side stairs for the specified product. If a product other than as specified is submitted, the Contractor shall also submit a revised plan indicating grades and walkway locations relating to the stairs of the proposed product for the Architect's approval.

1.6 DESIGN CRITERIA

- A. Applicable Codes: All design, materials, and workmanship shall be in accordance with the following:
 - NFPA 101 and 102, Current Edition
 - NYCRR, Current Edition
 - International Building Code (IBC), 2009 Edition/ICC 300 2007
- B. Design Loads:

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Live Loads:	Uniform Loading - Structure = 100 PSF Uniform Loading - Seat and Foot Planks = 120 PLF
Sway Loads:	Perpendicular to Seats = 10 Pounds per Lineal Foot Parallel to Seats = 24 Pounds per Lineal Foot
Wind Loads:	Basic Design Wind Speed = 150 MPH (Exposure "B")
Rail Loads:	Uniform Vertical Load = 100 Pounds per Lineal Foot Uniform Horizontal Load = 50 Pounds Per Lineal Foot Concentrated Horizontal Load = 200 LBS

- C. General: The structure shall be properly braced for wind and construction loads until all structural elements are secured. Individual stringer supports will not be allowed. Guardrails shall be of adequate size, location, and height to meet specified codes and designed to carry required loads.
- D. Foundations: Foundation design shall be based upon assumed minimum soil bearing capacity of 1,000# psf. Soil bearing capacity to be verified by design Engineer prior to placement of footings. Bleacher frame dead and live load 750 lbs/ft. Bleacher frame wind uplift load 250 lbs/ft. (150 mph). Unless otherwise noted on the drawings the bleacher frames shall be attached to the concrete with 3/8" dia. x 3-1/2" wedge type expansion anchors. The anchors shall be embedded a minimum of 2-3/8" into the concrete.
- E. Deflection: Structural elements shall be sized to limit the live load deflection to 1/200 of span.

1.7 WARRANTY

All products shall carry, after proper erection, and under normal use for the type of structure, a one (1) year warranty against all defects in materials and workmanship from the date of substantial completion. In addition, all aluminum plank extrusions shall be covered by a five (5) year warranty against deterioration of anodized finish or loss of structural strength due specifically to constant exposure to changing weather and environmental conditions. Acts of vandalism or abuse shall render the conditions of these warranties null and void.

1.8 PRODUCT LIABILITY INSURANCE

Shall be carried for the life of the product in the amount of \$2,000,000.

PART 2 - PRODUCTS

2.1 ELEVATED ANGLE FRAME BLEACHERS

Provide new bleachers consisting of 2 units, 8 rows high x 91'-6" long, with the accessories and features defined below. Net seating capacity per unit of 362 + 13 H.C. (not including aisles, based on 18" per seat).

2.2 UNDERSTRUCTURE

The understructure of each unit shall consist of a series of frames. Standard dimensions are 8" rise per row, 17" height of seats above foot plant, and 24" depth row. Framework shall be

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structural aluminum. Each frame shall consist of vertical, horizontal and diagonal bracing to support the seat and foot planks as specified herein. Bolted or otherwise mechanical fastening of each frame's components will not be acceptable. All cross-bracing and horizontal bracing is to be aluminum angle 6061-T6 (or mechanically equivalent) and placed in number and location to sustain design loads. Internal splicing where required shall be two per joint and shall penetrate the joint a minimum of 8" in each direction and be riveted at one end only to allow construction and expansion.

2.3 SEAT PLANK

Shall be anodized aluminum, nominally 2" x 10" with a wall thickness nominally .078". All seat planks shall be of aluminum alloy 6063-T6, and have a clear anodic coating (204R1) applied in accordance with AAS Standard AA-M10C22A31. Anodized end caps on all rows.

2.4 FOOT PLANK/TREAD

Shall be aluminum, non-skid surface nominally 2" x 10", footrest shall consist of 2 such planks with a wall thickness nominally .078" with anodized end caps. All foot planks shall be of aluminum alloy 6063-T6, and be mill finish.

2.5 VERTICAL RISERS

Vertical rise plank shall be provided between seat and foot plank and be mill finish. Plan shall be 2" x 10" at top row only and 1" x 6" on all other rows with a wall thickness nominally .078" fastened by clip sets. End caps shall be field installed using mechanical fasteners on all vertical risers and have clear anodic finish.

2.6 AISLES

Aisle footboards shall be of aluminum alloy 6083-T6 and be of mill finish contrasting aisle markings. Three aisle stiffener angles shall be used to strengthen the aisle step. There shall be 3 aisles, 54" wide, located as required by the applicable codes defined above.

2.7 AISLE HANDRAILS

Where there is seating on both side of the aisle, handrails located within the aisle shall be discontinuous with gaps or breaks at intervals not exceeding 3 rows to facilitate access to seating to permit crossing from one site of the aisle to the other. These gaps or breaks shall have a clear width of at least 22 inches and not greater than 36 inches, measured horizontally. Where handrails are provided in the middle aisle stairs, there shall be an intermediate handrail located approximately 12 inches below the main handrail. The handrail shall have clear anodic finish and also have rounded terminations or binds.

2.8 FRONT WALKWAY

There shall be a front walkway 30" high and 63" in clear width and shall be 7 planks arranged side by side to form a safe walkway platform, aluminum alloy 6061-T6 mill finish. Walkway plan shall be aluminum, non-skid surface nominally 2" x 10" with a wall thickness of .078". Understructure shall be constructed from same materials as specified in understructure above. Front railing shall consist of a 1-5/8" OD Schedule 40 aluminum alloy 6105-T5 clear anodized

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204R1 top horizontal pipe rail, and intermediate horizontal pipe rail and a 1" x 6" toeboard. Rail pipe shall attach to upright members by means of heavy duty tension bands using 3/8" diameter carriage bolts, lock washers and nuts with a hot dipped galvanized finish and consist of internal splice connectors, elbows, and pipe caps mechanically fastened.

2.9 ENTRY STEPS

There shall be one (1)sets of entry steps. Frames shall be of mill finish aluminum angle, 6061-T6 or mechanically equivalent and shall be 30" high and 63" in clear width. Guardrail and handrails shall be provided for stairs as required. Stairs shall be aluminum, non-skid surface nominally 2" x 12" with a wall thickness of .078".

2.10 GUARD RAILING

The railing shall consist of upright members of clear anodic finish extruded aluminum angle. Horizontal members shall be of extruded anodized aluminum tube 1-5/8" O.D. (schedule 40 pipe). Rail pipe shall attach to upright members by means of heavy duty tension bonds using 3/8" diameter carriage bolts, lock washers and nuts with a hot dipped galvanized finish and consist of internal splice connectors, elbows, and pipe caps mechanically fastened. The guard railing system shall be a chain link system consisting of 3 side rails and 2 back rails, with a top rail height of 42" and a maximum opening of less than 4". Guardrail shall consist of 9 gauge, 2" mesh aluminized chain link fabric, tension bars, brace bands, combo rail end caps and wire ties.

2.11 END CAPS

Shall be extruded aluminum, 6063-T6 alloy, and have a clear anodic coating (204R1) applied in accordance with AAS Standard AA-M10C22A31. All end caps are anodized and shall be field installed. End caps shall also be mechanically fastened on the underneath side of each plank with rivets and have smooth edges for safety.

2.12 CLIP SETS

Shall adequately connect seat and foot planks to the supporting structure so as to transmit all design loads to the understructure members, as specified in the design section. All planks shall be connected to the supporting structure using four-way adjustable clips, carriage bolts, lock washers, and hex nuts of 5/16" steel with a hot dipped galvanized finish.

2.13 ANCHOR BOLTS

Shall be 3/8" diameter x 3-1/2" long " wedge type" concrete anchor, with a minimum of 2-3/8" penetration in concrete foundation as specified below. The anchor bolt load capacity shall meet the minimum working load requirements of a tension capacity of 1200 lbs and a sheer capacity 1300 lbs. These loads shall be based on testing conducted according to ASTM Standard E488, and in compliance with AISI, UL, FM and ICBO.

2.14 CONCRETE FOUNDATION

The bleacher system uplift anchoring system is based on the assumption of the concrete foundation meeting a minimum of 4500 psi compressive strength which is in full compliance with ACI 318 and 301, (American Concrete Institute, Specifications for Structural Concrete for

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Buildings). The foundation system shall be design to meet the following minimum loading requirements:

Bleacher System Frames typically at 6'-0" o.c.
Bleachers frame base uniform total loading D.L. + L.L. 750 plf (unfactored)
Bleacher frame base uniform wind uplift loading 250 plf (unfactored)
Seismic Loading Requirements per local requirements

All exterior concrete shall be air-entrained as specified in 321301.

Reinforcing steel shall be in accordance with ASTM A615, grade 60.

Embedment of reinforcing in concrete shall be as follows, unless otherwise noted on drawings:

3" Placed directly against earth
2" Concrete poured against forms and exposed to weather

2.15 HANDICAP AREAS

- A. Handicap seating will be enclosed on all three sides with guardrailing. No exposed vertical rise is allowed in the handicap area.
- B. All handicap spaces will have handicap seating in pairs to two. All handicap seating will have adjacent companion seat.
- C. All handicap seating will have a clear unobstructed view of playing field. Spectator traffic will not be allowed to obstruct handicap viewing, per federal ADA.

2.16 CONCRETE PAD

- A. Concrete pad shall be as described in Section 321301.

2.17 ASPHALT

- A. The asphalt walk to the concrete pad shall be porous asphalt as described in Section 321202.

2.18 HARDWARE

- A. Bolts and nuts shall be hot dipped galvanized.

2.19 STANDARD OF QUALITY

- A. Shall be as manufactured by National Recreation Systems, Inc. (888)-568-9064, E&D Specialties (800)-525-8515, or Architect approved equal.

3.0 PART 3 - EXECUTION

3.1 INSTALLATION OF BLEACHERS

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- A. All work shall be performed by factory trained technicians, experienced in bleacher/bleacher seating installation.
- B. Completed installation shall be as shown on plans and on approved shop drawings.

3.2 CONCRETE FOUNDATIONS AND PADS

- A. Grade subgrade parallel to the finished grade. Check for unstable areas in the presence of the Architect.
- B. Install as described in Section 321301.

3.3 CLEAN UP

During the contract and at intervals as directed by the Architect and as fixed bleacher installation is completed, clear the site of all extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323005

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SECTION 323006 - NON-ELEVATED ALUMINUM BLEACHERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the semi-closed deck fixed bleachers are shown on the drawings. Make all transition connections smooth and in a neat workmanlike condition.
- B. Approximately 256 seat fixed non-elevated angle frame bleachers include, but are not limited to, the following:
 - 1. Concrete pad and footings
 - 2. Structural aluminum framing
 - 3. Aluminum seats, semi-closed deck and guardrail fencing, stairs, and railings
 - 4. Double foot planks for all rows
 - 5. Cleanup
- C. Access for bleachers shall be by means of stairs and seats meeting pavement as shown on drawings.
- D. Provide all materials, labor, equipment and services required to accomplish all related work in accordance with the drawings and specifications. Provide all design, engineering, freight, installation, supervision, state approvals, and inspections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 321201 - Asphalt Paving
- C. Section 321301 - Site Concrete Work

1.3 SUBMITTALS/APPROVALS

- A. Materials Certificates: Provide copies for each material from material producer, stamped as checked and approved by the Contractor before submittal to the Architect. Each material shall be certified by an approved independent testing laboratory as complying with or exceeding the specified requirements. Submit certificates to Architect a minimum of two (2) weeks prior to installation for 4,500 psi concrete.
- B. Design Calculations: Design calculations shall be submitted for review by the Architect. The calculations shall bear the seal and signature of a licensed New York State Professional Engineer and shall present an analysis that will indicate the structural members are of sufficient strength to support the design loads. This analysis shall also indicate that the structural members are able to resist deformations caused by such design loads to which they may be subjected, without exceeding the allowable stresses of the materials. Grandstands shall be in accordance with the New York State Labor and Industry, Title 34, Chapter 15- Grandstands. All fees for review and inspection shall be paid by the contractor.

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- C. Shop drawings shall include all specified products, seating plan, aisles, walkways, seating sections and exits. Provide end elevations indicating rise and row depth, deck configuration and method of attachment, railings, size of framing members, vertical aisle details, and walkways.
- D. Samples:
 - Seatboard
 - Footboard
 - Riserboard
 - Handrail support post and cap
 - 12" x 12" chain link
 - Deck attachment support member
 - Intermediate step
 - Seating mounting bracket - "L" type to meet BOCA and NFPA codes
- E. Seating plan indicating aisles, walkways, seating sections, and exits.
- F. Schedule of work experience, including names and telephone numbers of contacts; 10 people minimum equal value.
- G. List of three similar jobs - should the Owners (three persons maximum) request a site visitation to these jobs, it will be at the bidders expense.
- H. Resume including Corporate Officers, Sales Representatives, Technical Advisor, Project Manager, and Job Site Superintendent.
- I. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: All design, fabrication and construction shall comply with the requirements of NFPA 101 and 102, NYCRR, and Americans with Disabilities Act, and International Building Codes/ICC 300 2017, whichever is more stringent. Current edition shall govern.
- B. Bidding: Contractor shall bid bleachers as detailed and specified. If modifications are required by regulatory agencies, changes will be incorporated into the contract at no additional cost to the Owner. Welders must conform to AWS Standards and local code requirements.
- C. For fabrication of the bleachers, use only personnel who are thoroughly trained and experienced in the fabrication of grandstands and bleachers. Seating shall be designed to meet or exceed specified fire and safety codes. Provide Product Liability Certificate of Insurance coverage for life of product.

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- D. List minimum of three (3) similar jobs for the Architect or Owner to review prior to accepting the suppliers bid proposal. Manufacturers must have a minimum of 10 years experience in the design and manufacturing of bleachers.
- E. Provide test reports certifying that the bleachers have been inspected and installed in accordance with the contract documents. This shall be performed by an independent testing agency hired by the contractor. The testing agency's representative shall be either a NYS licensed Professional Engineer or working under the direct supervision of a NYS licensed Professional Engineer. The inspection shall include examination of:
 - 1. High strength bolted connections for general conformance with the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts". The connections shall be examined to confirm a "snug tight" condition with all plies in intimate contact.
 - 2. General conformance with the AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" to confirm that all nuts are "run down".
 - 3. Confirmation of non-slip finish installation.

1.5 JOB CONDITIONS

- A. All job conditions in Section 311201 apply.
- B. Verify site location of bleachers and locate all underground utilities. Visit site as described in Section 311201.
- C. NY State Professional Engineer (PE) hired by the bleachers' supplier will determine soil bearing capacity of on site soils from provided soil boring, pit information, and additional testing as the PE deems necessary. The PE is solely responsible for design interpretations and subsequent design of the bleachers.
- D. The contract documents provided by the Owner include existing and proposed grades.
- E. The contract documents indicate grades, approximate pier locations and walkways to meet the side stairs for the specified product. If a product other than as specified is submitted, the Contractor shall also submit a revised plan indicating grades and walkway locations relating to the stairs of the proposed product for the Architect's approval.

1.6 DESIGN CRITERIA

- A. Applicable Codes: All design, materials, and workmanship shall be in accordance with the following:
 - NFPA 101 and 102, Current Edition
 - NYCRR, Current Edition
 - International Building Code (IBC), 2009 Edition/ICC 300 2007
- B. Design Loads:
 - Live Loads: Uniform Loading - Structure = 100 PSF

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Sway Loads:	Uniform Loading - Seat and Foot Planks = 120 PLF Perpendicular to Seats = 10 Pounds per Lineal Foot Parallel to Seats = 24 Pounds per Lineal Foot
Wind Loads:	Basic Design Wind Speed = 150 MPH (Exposure "B")
Rail Loads:	Uniform Vertical Load = 100 Pounds per Lineal Foot Uniform Horizontal Load = 50 Pounds Per Lineal Foot Concentrated Horizontal Load = 200 LBS

- C. General: The structure shall be properly braced for wind and construction loads until all structural elements are secured. Individual stringer supports will not be allowed. Guardrails shall be of adequate size, location, and height to meet specified codes and designed to carry required loads.
- D. Foundations: Foundation design shall be based upon assumed minimum soil bearing capacity of 1,000# psf. Soil bearing capacity to be verified by design Engineer prior to placement of footings. Bleacher frame dead and live load 750 lbs/ft. Bleacher frame wind uplift load 250 lbs/ft. (150 mph). Unless otherwise noted on the drawings the bleacher frames shall be attached to the concrete with 3/8" dia. x 3-1/2" wedge type expansion anchors. The anchors shall be embedded a minimum of 2-3/8" into the concrete.
- E. Deflection: Structural elements shall be sized to limit the live load deflection to 1/200 of span.

1.7 WARRANTY

- A. All products shall carry, after proper erection, and under normal use for the type of structure, a one (1) year warranty against all defects in materials and workmanship from the date of substantial completion.
- B. In addition, all aluminum plank extrusions shall be covered by a five (5) year warranty against deterioration of anodized finish or loss of structural strength due specifically to constant exposure to changing weather and environmental conditions.

1.8 PRODUCT LIABILITY INSURANCE

Shall be carried for the life of the product in the amount of \$2,000,000.

PART 2 - PRODUCTS

2.1 NON-ELEVATED ANGLE FRAME BLEACHERS

- A. Production Description: Provide new bleachers consisting of 6 units, 8 rows high x 30'-9" long, with the accessories and features defined below. Net seating capacity per unit of 128 + 4 H.C. (not including aisles, based on 18" per seat).
 - 1. Framework: Prefabricated aluminum angle spaced at 6'-0" intervals jointed by means of aluminum angle cross bracing.
 - 2. Shop Connections: Welded to meet AWS standards and local code requirements.

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3. Joint Sleeve Assembly: Internal splices, where required shall be two per joint, and shall penetrate the joint a minimum of 8" in each direction and be riveted at one end only to allow for contraction and expansion.
 4. Rise and Depth of Dimensions: 8" vertical rise and 24" tread depth, seat height is 17" above its respective tread.
 5. Seats: Nominal 2" x 10" anodized aluminum with anodized end caps.
 6. Treads: Nominal two (2) 2" x 10" mill finish aluminum with anodized end caps on rows 2 and up.
 7. Risers:
 - a. Nominal two (2) 1" x 6" mill finish aluminum with mill finish end caps on top row.
 - b. Nominal 1" x 6" mill finish aluminum with end caps on all other rows.
 8. Aisles: Aisle footboards shall be of aluminum alloy 6063-T6 and be mill finish with contrasting aisle markings. Three aisle stiffener angles shall be used to strengthen the aisle step. There shall be 2 aisle(s) 54" wide.
 9. Aisle Handrail: Anodized pipe with intermediate rail.
 10. Guardrail: Shall be anodized aluminum tube with end plugs and elbows where required. All rails shall be secured to angle supports with galvanized fasteners. Top rails at sides, rear and front shall be 42" above the leading edge of seat or walking surfaces. Rear rail support members shall be aluminum channel, side and front rail supports shall be aluminum angle.
 - a. Chainlink system: Fencing shall consist of 9 gauge, 2" mesh galvanized chainlink fabric, heavy duty tension bands, tension bars, brace bands, combo rail endcaps, and wire ties.
 11. Handicap Accessibility: Shall be provided as required by the code listed above.
- B. Materials/Finishes:
1. Framework:
 - a. Aluminum: Structural fabrication with aluminum alloy 6061-T6 finish. Each frame shall be unit-welded, using metal inert gas method, under guidelines by the American Welding Society. After fabrication all steel is hot dipped galvanized to ASTM A-123 specifications. All crossbracing and horizontal bracing shall be aluminum angle 6061-T6 mill finish.
 2. Extruded Aluminum:

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- a. Seat Planks: Aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II with a wall thickness nominally .078" for impact and deformation resistance.
- b. Tread and Riser Planks: Aluminum alloy 6063-T6, mill finish with a wall thickness nominally .078" for impact and deformation resistance.
- c. Guardrail Pipe: 1-5/8 OD schedule 40 aluminum alloy 6105-T5, clear anodized 204R1, AA-M10C22A31, Class II

3. Accessories:

- a. Channel End Caps: Aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II.
- b. Hardware: Bolts, nuts, shall be hot dipped galvanized.
- c. Hold-Down Clip Assembly: Aluminum alloy 6063-T6, mill finish.
- d. Joint Sleeve Assembly: Aluminum alloy 6061-T6, mill finish.

2.2 ANCHOR BOLTS

Shall be 3/8" diameter x 3-1/2" long " wedge type" concrete anchor, with a minimum of 2-3/8" penetration in concrete foundation as specified below. The anchor bolt load capacity shall meet the minimum working load requirements of a tension capacity of 1200 lbs and a shear capacity 1300 lbs. These loads shall be based on testing conducted according to ASTM Standard E488, and in compliance with AISI, UL, FM and ICBO.

2.3 CONCRETE FOUNDATION

The bleacher system uplift anchoring system is based on the assumption of the concrete foundation meeting a minimum of 4,500 psi compressive strength which is in full compliance with ACI 318 and 301, (American Concrete Institute, Specifications for Structural Concrete for Buildings). The foundation system shall be design to meet the following minimum loading requirements:

Bleacher System Frames typically at 6'-0" o.c.
Bleachers frame base uniform total loading D.L. + L.L. 750 plf (unfactored)
Bleacher frame base uniform wind uplift loading 250 plf (unfactored)
Seismic Loading Requirements per local requirements

All exterior concrete shall be air-entrained as specified in 321301.

Reinforcing steel shall be in accordance with ASTM A615, grade 60.

Embedment of reinforcing in concrete shall be as follows, unless otherwise noted on drawings:

- 3" Placed directly against earth
- 2" Concrete poured against forms and exposed to weather

2.4 HANDICAP AREAS

- A. Handicap seating will be enclosed on all three sides with guardrailing. No exposed vertical rise is allowed in the handicap area.

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- B. All handicap spaces will have handicap seating in pairs to two. All handicap seating will have adjacent companion seat.
- C. All handicap seating will have a clear unobstructed view of playing field. Spectator traffic will not be allowed to obstruct handicap viewing, per federal ADA.

2.5 CONCRETE PAD

- A. Concrete pad shall be as described in Section 321301.

2.6 ASPHALT

- A. The asphalt walk to the concrete pad shall be porous asphalt as described in Section 321202.

2.7 HARDWARE

- A. Bolts and nuts shall be hot dipped galvanized.

2.8 STANDARD OF QUALITY

- A. Shall be as manufactured by National Recreation Systems, Inc. (888)-568-9064, E&D Specialties (800)-525-8515, or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF BLEACHERS

- A. All work shall be performed by factory trained technicians, experienced in bleacher/bleacher seating installation.
- B. Completed installation shall be as shown on plans and on approved shop drawings.

3.2 CONCRETE FOUNDATIONS AND PADS

- A. Grade subgrade parallel to the finished grade. Check for unstable areas in the presence of the Architect.
- B. Install as described in Section 321301.

3.3 CLEAN UP

During the contract and at intervals as directed by the Architect and as fixed bleacher installation is completed, clear the site of all extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323006

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SECTION 3230007 – SCOREBOARD(S)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Two (2) Single-sided LED Multi-Sport Scoreboards with Integrated Sports Statistics and Interactive LED Video Displays
- B. Two (2) Sets of Single-sided LED Timing Displays
- C. Three (3) Single-sided LED Little League/Softball Scoreboards
- D. Decorative Accents and Non-illuminated Panels
- E. Control Equipment for Scoreboard and Integrated Video Displays

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 321301 - Site Concrete Work

1.3 REFERENCES

- A. Standard for Electric Signs, UL-48, 14th Edition
- B. Standard for Control Centers for Changing Message Type Signs, UL-1433, 4th Edition
- C. Standard for CAN/CSA C22.2 No. 207-M89
- D. Federal Communications Commission Regulation Part 15
- E. National Electric Code

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation that comply with these specifications and 1.5 "Quality Assurance" of this specification section.
- B. Shop drawings: Submit mechanical and electrical drawings.
- C. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. For outdoor use

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- B. Source limitations: To ensure consistency of appearance and compatibility, obtain each scoreboard, video display, decorative truss, non-illuminated panel, delay of game clocks, control equipment, and software from a single manufacturer.
- C. All proposed equipment and models of equipment must be standardized, previously designed, and documented with current reliability records, product cut sheets, and shop drawings. Custom-designed equipment will not be acceptable.
- D. ETL listed to UL Standards 48 and 1433
- E. NEC compliant
- F. FCC Class A compliant
- G. ETL listed to CAN/CSA 22.2
- H. Installer’s qualification: Business familiar in the installation of systems similar in complexity to those essential for this project; and fulfillment of the following:
 - 1. At least (5) five years’ experience with systems of the specified types and products included.
 - 2. Provide examples of three (3) previous installations, located within 150 miles of project, of similar stadium scoreboard designs – integrating Real Time Data from a fixed digit LED scoreboard and controller within the digital display of an LED video/matrix display, allowing the video display to act as a “virtual scoreboard”.
 - 3. Retain a fully staffed and equipped service facility within 150 miles of project.
 - 4. Installer to be factory educated in the installation and maintenance of any digital signal processed based control systems, specified here in.
 - 5. At the request of the owner, the Installer must demonstrate that he has:
 - a. Sufficient plant and equipment to complete the work within the agreed timetable.
 - b. Sufficient staff with commensurate technical experience.
 - c. Appropriate financial status to meet the obligations of the work.

1.6 JOB CONDITIONS

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

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Product delivered on-site.
- B. Scoreboards and equipment to be housed in a clean, dry environment.

1.8 WARRANTY

- A. Provide five (5) years of factory warranty on permanently mounted scoreboards and LED video displays, including LEDs and wireless control equipment.
- B. Provide one (1) year warranty for laptop computers, iPads and battery operated equipment.
- C. Provide 10 years of guaranteed availability of original parts for all equipment from the scoreboard manufacturer.
- D. Provide an established and on-going exchange program, with at least ten years of proven effectiveness, to supply replacement parts for any/all components that fail during the coverage period. To minimize downtime, the exchange parts shall be shipped on the same day the order is received or the following day. The manufacturer will include an air bill for the return of the defective components.
- E. Provide toll-free service coordination.
- F. Provide technical phone and on-site support during regular Eastern Time Zone business hours.

PART 2 - PRODUCTS

2.1 STANDARD OF QUALITY

- A. Shall be Daktronics, Inc., 201 Daktronics Drive, P.O. Box 5128, Brookings, South Dakota 57006-5128 or Architect approved equal.

2.2 MULTI-SPORT LED SCOREBOARDS (QTY. 2)

- A. Daktronics MS-2030 single-sided multi-sport scoreboard displays period time to 99:59, HOME and GUEST scores to 99, PERIOD to nine, and indicates team penalty. During the last minute of the period, the clock displays time to 1/10 of a second.
- B. General Information
 - 1. Dimensions: 4'-6" (1.37 m) high, 18'-0" (5.49 m) wide, 0'-8" (203 mm) deep
 - 2. Base weight: 428 lb
 - 3. Power requirement: 580 W
 - 4. Color: Provide over 150 colors to choose from
- C. Construction

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1. Alcoa aluminum alloy 5052 construction for excellent corrosion resistance.
2. To avoid oil canning or waves in the face of the aluminum, no mechanical fasteners (screws, rivets or welds) shall be used to attach the face to the scoreboard body frame. Commercial sign tape shall be used to cover 100% coverage on all face attachment points.
3. The scoreboard cabinet structure shall not have any internal vertical or horizontal members spaced more than 42" O.C.
4. The cabinet shall be one continuous structure without any vertical seams to be stitched together.
5. Scoreboard shall be able to be mounted to two (2) vertical columns and a have documented engineering data reflecting the ability of the cabinet to withstand wind pressure up to 72 lbs./sq. ft. with vertical I-beam spacing up to 13'-0" O.C.
6. Scoreboard back, face, and perimeter: 0.063" (1.60 mm) thick
7. Scoreboard top and bottom shall be a minimum of 0.125" (3.18 mm) thick extruded aluminum for added strength and to eliminate sagging.
8. Digit faceplates: 0.063" (1.60 mm) thick
9. All scoreboard, video display, decorative truss, and non-illuminated panel attachments to the beam structure shall be fastened only to the front flange of the beam.
10. Each scoreboard, video display, decorative truss, and non-illuminated panel cabinet shall require no more than one pair of mounting clamps per vertical column at the top and bottom of each cabinet.
11. Mounting shall not require any drilling, welding, or fastening hardware that penetrates the scoreboard, video display, decorative truss, and non-illuminated cabinets.

D. Digits and Drivers

1. Digit color: White
2. HOME, GUEST, and clock digits: 24" (610 mm) high
3. PERIOD digit: 18" (457 mm) high
4. Seven bar segments per digit
5. TS AllnGaP Light Emitting Diodes (LEDs)
6. PanaView® LED 140 degree digit technology. LED elements must protrude from scoreboard face and should not include any plastic, reflective protective face cover All components of each LED digit shall be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof.
7. Individual digit panels are to be fastened with a maximum of four screws for easy access and quick removal. Rivets are not an acceptable fastening method. Lexan covers shall not be used.
8. All digits must be serviceable from the front of the display.
9. Digit drivers and circuit boards within the scoreboard must be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof.

E. Captions

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1. Programmable white LED electronic HOME, GUEST, and PERIOD captions: 10.6” (269 mm) high.

F. Required Additional Equipment

1. Vinyl striping around the scoreboard face.
2. Weatherproof trumpet horn.
3. Dual purpose 2.4 GHz spread spectrum radio control receiver mounted within the scoreboard cabinet to allow for control of scoreboard, wirelessly via mobile cell phone device and from the press box via the All Sport Pro iPad, the Dak Score mobile app, and full-featured All Sport control console.
4. Daktronics IDA-1001-18 decorative truss (3’-0” [914 mm] high x 18’-0” [5.49 m] wide) above the scoreboard with backlit (illuminated) lettering or logo.
 - a. Must be constructed of 100% aluminum.
 - b. Aluminum members shall be a combination of 2” x 2” and 3” x 3” square tubes and angles.
 - c. Letters and logos must be a minimum of 36” in height.
 - d. To maintain consistency in paint color and longevity, all truss painting shall be completed by the same manufacturer as the scoreboard and school identification panels.
5. Two (2) Daktronics non-illuminated 2’-0” (610 mm) high x 18’-0” (5.49 m) wide x 7” (178 mm) deep aluminum panel shall be included at the bottom of the scoreboard per system.
 - a. Must be constructed of 100% aluminum.
 - b. Aluminum sides and top of panel must extend a minimum of 7” behind the face of the sign.
 - c. To maintain consistency in paint color and longevity, all identification panel painting and manufacturing shall be completed by the same manufacturer as the scoreboard, and decorative trusses.
 - d. Aluminum panels must clamp to the flange of the I-beams requiring no drilling or welding.

2.3 LED INTEGRATED VIDEO DISPLAY (QTY. 2)

- A. Daktronics LVX single-sided display in a two-section cabinet extending the entire width of the display and shall be equipped to complement the specified outdoor scoreboard. The LVX outdoor display shall use one red, one green, and one blue lamp-style LEDs to form pixels. Display shall be capable of displaying live and recorded full length video files up to 3 hours per file, real-time-data (RTD) produced by the scoreboard control console including: BALL ON, YARD TO GO, DOWN, QUARTER, TIME OUTS LEFT, SHOTS, SAVES, PLAYER NUMBER, PENALTY, among other information that can be displayed directly via network connection of the All Sport scoreboard console, custom animations, 35 pre-created sports themed animations, photographs, and other .jpg files. System shall also be capable of displaying data from 3rd party sources.
1. Matrix pixel layout: 168x288
 2. Cabinet width: 18’-0” (5.49 m) wide
 3. Display area: 9’-2.25” (2.8 m) high x 15’-9” (4.8 m) wide
 4. Weight: 1,725 lbs

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5. Power requirements: 3,900 W max
Line 1 is 19.6 Amps; Line 2 is 17.6 Amps
6. Two integrated filler panels into a single cabinet. Video display cabinets should be one continuous horizontal cabinet without any vertical seams to be stitched together.

B. Construction

1. All-aluminum construction for light weight and corrosion resistance.
2. Service access: Front and rear
 - a. Rear access by removable panels with no special tools (hinged access panels not acceptable).
3. The back of the display cabinet shall be a minimum of 3” from any vertical structural beam to allow for removal of back access panels.
4. Display must incorporate an internal spare parts/service rack which provides space for spare modules, PLRs, power supplies, and included standard service tools inside the display cabinet.

C. Display Capabilities

1. Gradations per color: 16,384
2. Color capability: 16 bit (281 trillion colors)
3. LED refresh rate: 4,800 Hz as defined by the number of times per second the LED image is repainted in intensity.
4. Display must have signal redundancy allowing for signal path both forward and backwards through modules allowing for loss of only 1 module vs. rows or blocks of multiple modules or panels in case of module failure. No visual disruption shall occur if only one signal path is disrupted (i.e. one signal cable or connector failed).
5. Display must have capability to be remotely accessed via an Internet connection to monitor, diagnose, and troubleshoot any issues related to the display. System shall be capable of identifying the location of any broken connection to/from the primary and/or redundant signal pathway.

D. Viewing Characteristics

1. Module intensity: 9,500 nits (adjustable)
2. Brightness control: 256 levels (manual, scheduled, or automatic)
3. Suggested viewing angle: 160° horizontal and +25°/-40° vertical

E. Pixel Characteristics

1. Each pixel consists of 3 through-hole LEDs per pixel (1 red, 1 green, 1 blue).
 - a. Pixels with an overbalance of one color (e.g. 2 red, 1 green, 1 blue) are not acceptable.
2. Pixel spacing measurement must be measured from the center points of neighboring physical pixels, rather than neighboring physical and virtual pixels.

F. LED Module Characteristics

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1. Module shall be for outdoor use.
2. Module shall have anti-reflective paint or coating applied to display face. To achieve required contrast, black state across all modules shall exhibit a Delta E color variation of no more than .4.
3. Modules shall have horizontal louvers running between LEDs or pixels.
4. Modules shall be able to be removed and installed from both the front and rear of the display.
5. It is not necessary to remove or insert screws in order to remove or install modules.
6. Module shall be silicon potted on face beneath louver and rear, providing a 100% waterproof seal, regardless of module, cabinet or panel construction.

G. Video Processing

1. Video frame rate: 50/60 frames per second
2. Graphic frame rate: 30 frames per second
3. Processing architecture: 22-bit distributed
4. System architecture: 100% digital
5. Video enhancement: Color space conversion, adjustable gamma correction, proprietary sharpening technology and enhancement algorithms for optimal picture quality.

H. LED Quality

1. Quality control: Sorted by intensity and color wavelength.
2. LED lifetime: 100,000 hours of operation as defined by time at which display intensity has decreased to 50 percent of the original intensity.

I. Calibration

1. Pixel-to-pixel and module-to-module optical color calibration must be performed at the factory. The manufacturer must also provide easy-to-use calibration software that allows individual modules and pixels to be independently adjusted while in the display.
2. If modules should need replacement during the life of the display, the calibration software must match newer modules' brightness levels to older modules' levels to preserve picture quality and maintain a uniform display appearance.

J. Required Redundancy

1. Each module shall have data delivered via two isolated communication paths, allowing the module to function fully should any data path fail.
2. Scoring console providing RTD data to the video display shall have alternate path of information via standalone standard All Sport console included within this project.
3. Video display shall instantly operate as full feature scoreboard should any component fail within the fixed digit scoreboard.

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- K. Sports Display and Real Time Data (RTD) Requirements
 - 1. System must be able to display live data supplied by All Sport 5000 control console with or without the use of the Show Control Software being open.
 - 2. Live data (Down, To Go, Ball On, Penalty Time, Shots On Goal, etc...) produced by the scoreboard control console must be able to be displayed directly to the integrated sports display without the requirement of any additional controllers or computers.
 - 3. System must be capable of displaying other sports software including DakStats live via network connections.

- L. Real-time data (RTD) integration allows operators to create messages with information that automatically updates without user intervention. Such data may include scores, game time, player/team statistics, time-of-day, date, or temperature.

2.4 VIDEO PRODUCTION AND DISPLAY EQUIPMENT

- A. Equipment Rack
 - 1. 12RU wall-mount rack
 - a. A wall-mount rack allows the control equipment to be located remotely from the gameday production location.
 - 2. Dimensions: 28" (711 mm) high x 23.4" (594 mm) wide x 26" (660 mm) deep

- B. Media Player
 - 1. Provide a Digital Media Player (DMP).
 - 2. Animation rates of up to 60 frames per second.
 - 3. Resolution: Up to 1080p 59.94
 - 4. Video input: SDI or HDMI up to 1080p 59.94
 - 5. Video output: DisplayPort to Video Image Processor
 - 6. Audio output: Balanced 3-pin XLR
 - 7. Ports: USB 2.0 @4, USB 3.0 @2
 - 8. Memory: 16 GB DDR4
 - 9. Storage: 1 TB
 - 10. Networking: 10/100/1000 Ethernet (RJ-45 LAN) @1
 - 11. Dimensions: Half-width 1RU; 1.75" (44.5 mm) high x 8.75" (222 mm) wide x 12" (305 mm) deep

- C. Video Processor
 - 1. Provide a Video Image Processor (VIP).
 - 2. Video input: DVI from Daktronics DMP
 - 3. Video output: Daktronics ProLink® 6 (fiber optic) @2
 - 4. Color space conversion: Proprietary LED conversion
 - 5. Networking: 10/100/1000 Ethernet (RJ-45 LAN) @1
 - 6. Dimensions: Half-width 1RU; 1.75" (44.5 mm) high x 8.75" (222 mm) wide x 12" (305 mm) deep

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- D. Network Router
 - 1. 8-port gigabit
- E. Remote Network Control Panel
 - 1. 8-button network control panel shall allow display operation when the primary control room is not accessible, or the Show Control laptop has been taken elsewhere.
 - 2. Power over Ethernet (PoE), a single Ethernet cable shall run between the existing control rack and the network control panel location, up to 250' (76 m) away from the rack.
 - 3. Shall allow for quick and easy selection of video screen layout (Football, Lacrosse, Soccer, Full Video, Sponsors, Player Head Shot, Practice Segment Timer) without requirement of a laptop computer or access to the press box.
 - 4. Shall be housed in a one-gang junction box: 4.13" high x 1.93" wide x 1.21" deep
- F. All Sport Pro Full Scoring Remote User Station for Scoring/Video Control
 - 1. Interface shall allow wireless control from the field via provided touchscreen tablet.
 - 2. Shall have the ability to assign common or custom rule profiles to fit the level of play.
 - 3. Shall display up to 16 display software hot buttons, allowing for i-click switching to differing video sequences
 - 4. Shall allow user to manually play content directly from the scoring control Ipad.
 - 5. Shall automatically play content via game triggers, such as when a team scores.
 - 6. Shall provide multiple data outputs to control fixed-digit scoreboards and send RTD to video displays.
 - 7. User shall have the ability to create custom color schemes for different teams/operators.
 - 8. Shall allow single Apple iPad control for both upper fixed digit scoreboard and video display.
 - 9. Shall communicate via hidden dual Band Wi-Fi Wireless network with provided Access Points (2.4/5.8 GHz)

2.5 CONTROL COMPUTER

- A. Laptop
 - 1. Operating system: Windows® 11 Pro
 - 2. Processor: Intel® Core™ i5
 - 3. Memory: 16 GB RAM
 - 4. Hard drive: 500 GB
 - 5. Form factor: Dell Latitude 5510
 - 6. Laptop may be removed from the control location so content can be created and modified elsewhere. When the laptop is reconnected to the rack, updated content is synced in a matter of minutes.

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2.6 CONTROL SOFTWARE

- A. Manufacturer must provide a Windows® 11 Pro based laptop computer with the control software loaded, configured, and ready to control display at startup.
- B. Must be developed, engineered and supported by the same manufacturer as the: scoreboard, video display, media player, and video processor. Third party software is NOT acceptable.
- C. The display's control software must provide simple, user-friendly features for creating, editing, scheduling, running and deleting messages.
- D. Display Software Features:
 - 1. Direct control of an infinite number of displays located on a network
 - 2. Simultaneous display and edit capability
 - 3. Content playlists with loop, shuffle, random and next play functionality
 - 4. Thumbnail preview of content clips
 - 5. Onscreen display monitor
 - 6. Unlimited, color-coded buttons with adjustable sizes
 - 7. Multiple operator workspaces
 - 8. Support input devices such as a mouse, keyboard, touch screen, and dual monitor
 - 9. Icon and pull-down menu programming features
 - 10. Help screens
- E. Content Editor Software Features:
 - 1. Display of TrueType fonts and other Windows® compatible character fonts
 - 2. Inline text editing
 - 3. Outlined, Drop shadowed, Bold, Italic, and Underlined text modes
 - 4. Ability to copy and paste text from most Windows applications
 - 5. Import common image and animation formats, including BMP, JPEG and AVI
 - 6. Content preview
 - 7. Content layering
 - 8. Real-time data (RTD) integration allows operators to create messages with information that automatically updates without user intervention. Such data may include scores, game time, player/team statistics, time-of-day, date or temperature.
 - 9. Profanity protection and Spell Check
 - 10. Multiple transition effects for entry, hold, and exit

2.7 DELAY OF GAME CLOCKS (QTY. 2 PAIR)

- A. Daktronics TI-2015 segment timer displays the segment number, which can be set to start flashing when a preset limit (warning time) is reached. An audible horn sounds at the end of segments. The timer can also be configured to count up or down from any preset number from 0 to 99 or used as a speed of pitch display for baseball.

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B. General Information

1. Dimensions: 2'-4" (711 mm) high, 3'-4" (1.02 m) wide, 0'-8" (203 mm) deep
2. Weight: 36 lb (16 kg) per clock
3. Power requirement: 75 W per clock
4. Color: Semi-gloss black

C. Construction

1. Alcoa aluminum alloy 5052 construction for excellent corrosion resistance.
2. To avoid oil canning or waves in the face of the aluminum, no mechanical fasteners (screws, rivets or welds) shall be used to attach the face to the scoreboard body frame. Commercial sign tape shall be used to cover 100% coverage on all face attachment points.
3. Display back, face, and perimeter: 0.063" (1.60 mm) thick

D. Digits and Drivers

1. Digit color: Red
2. Clock digits: 24" (610 mm) high
3. Seven bar segments per digit
4. TS AllnGaP Light Emitting Diodes (LEDs)
5. PanaView® LED 140 degree digit technology. LED elements must protrude from scoreboard face and should not include any plastic, reflective protective face cover All components of each LED digit shall be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof.
6. All digits must be serviceable from the front of the display.
7. Digit drivers and circuit boards within the scoreboard must be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof.

E. Horn

1. Vibrating horn mounted inside the scoreboard cabinet behind face.
2. Sounds automatically when period clock counts down to zero.
3. Sounds manually as directed by operator.

F. Additional Required Equipment

1. Individual digit protective screens.
2. Four-wheel cart for portability.
3. Dual purpose 2.4 GHz spread spectrum radio control receiver mounted within the scoreboard cabinet to allow for control of scoreboard, wirelessly via mobile cell phone device and from the press box via the All Sport Pro iPad, the Dak Score mobile app, and full-featured All Sport control console.

2.8 LED LITTLE LEAGUE/SOFTBALL SCOREBOARDS (QTY. 3)

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- A. Daktronics BA-2022 single-sided baseball scoreboard shall display HOME and GUEST team scores for up to seven innings, total RUNS to 99 for each team, BALL to three, STRIKE to two and OUT to two.

- B. General Information
 - 1. Dimensions: 6'-6" (1.98 m) high, 16'-0" (4.88 m) wide, 0'-8" (203 mm) deep
 - 2. Base weight: 525 lb (238 kg)
 - 3. Base power requirement: 395 W
 - 4. Color: Provide over 150 colors to choose from

- C. Construction
 - 1. Alcoa aluminum alloy 5052 construction for excellent corrosion resistance.
 - 2. To avoid oil canning or waves in the face of the aluminum, no mechanical fasteners (screws, rivets or welds) shall be used to attach the face to the scoreboard body frame. Commercial sign tape shall be used to cover 100% coverage on all face attachment points.
 - 3. The scoreboard cabinet structure shall not have any internal vertical or horizontal members spaced more than 42" O.C.
 - 4. The cabinet shall be one continuous structure without any vertical seams to be stitched together.
 - 5. Scoreboard shall be able to be mounted to two (2) vertical columns and a have documented engineering data reflecting the ability of the cabinet to withstand wind pressure up to 72 lbs./sq. ft. with vertical I-beam spacing up to 10'-0" O.C.
 - 6. Scoreboard back, face, and perimeter: 0.063" (1.60 mm) thick
 - 7. Scoreboard top and bottom shall be a minimum of 0.125" (3.18 mm) thick extruded aluminum for added strength and to eliminate sagging.
 - 8. Digit faceplates: 0.063" (1.60 mm) thick
 - 9. All scoreboard, decorative truss, and non-illuminated panel attachments to the beam structure shall be fastened only to the front flange of the beam.
 - 10. Each scoreboard, decorative truss, and non-illuminated panel cabinet shall require no more than one pair of mounting clamps per vertical column at the top and bottom of each cabinet.
 - 11. Mounting shall not require any drilling, welding, or fastening hardware that penetrates the scoreboard, decorative truss, and non-illuminated panel cabinets.

- D. Digits and Drivers
 - 1. Digit Color: White
 - 2. BALL, STRIKE, OUT, inning scores, and RUNS digits: 15" (381 mm) high
 - 3. Seven bar segments per digit
 - 4. TS AlInGaP Light Emitting Diodes (LEDs)
 - 5. PanaView® LED 140 degree digit technology. LED elements must protrude from scoreboard face and should not include any plastic, reflective protective face cover All components of each LED digit shall be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof.
 - 6. Individual digit panels are to be fastened with a maximum of four screws for easy

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access and quick removal. Rivets are not an acceptable fastening method. Lexan covers shall not be used.

7. All digits must be serviceable from the front of the display.
8. Digit drivers and circuit boards within the scoreboard must be encapsulated in a minimum of 1/8" thick, potting material, front and back allowing the entire unit to be 100% waterproof.

E. Captions

1. Vinyl applied directly to scoreboard face.
2. HOME and GUEST captions: 10" (254 mm) high
3. BALL, STRIKE, and OUT captions: 9" (229 mm) high
4. Inning numbers and RUNS captions: 8" (203 mm) high
5. Color: Standard white

F. Additional Required Equipment

1. Vinyl striping around the scoreboard face.
2. Dual purpose 2.4 GHz spread spectrum radio control receiver mounted within the scoreboard cabinet to allow for control of scoreboard, wirelessly via mobile cell phone device and from the press box via the Dak Score mobile app and full-featured All Sport control console.
3. Daktronics IDA-1001-16 decorative truss (3'-0" [914 mm] high x 16'-0" [4.88 m] wide) above the scoreboard with backlit (illuminated) lettering or logo.
 - a. Must be constructed of 100% aluminum.
 - b. Aluminum members shall be a combination of 2" x 2" and 3" x 3" square tubes and angles.
 - c. Letters and logos must be a minimum of 36" in height.
 - d. To maintain consistency in paint color and longevity, all truss painting shall be completed by the same manufacturer as the scoreboard and school identification panels.
4. Two (2) Daktronics non-illuminated 2'-0" (610 mm) high x 16'-0" (4.88 m) wide x 7" (178 mm) deep aluminum panel shall be included at the bottom of the scoreboard per system.
 - a. Must be constructed of 100% aluminum.
 - b. Aluminum sides and top of panel must extend a minimum of 7" behind the face of the sign.
 - c. To maintain consistency in paint color and longevity, all identification panel painting and manufacturing shall be completed by the same manufacturer as the scoreboard, and decorative trusses.
 - d. Aluminum panels must clamp to the flange of the I-beams requiring no drilling or welding.

3.9 SCORING CONSOLES: ALL SPORT 5000 FOR MULTI-SPORT & LITTLE LEAGUE/SOFTBALL FIELDS, MX-1 FOR HANDHELD PORTABILITY, AND ALL SPORT PRO FOR WIRELESS CONTROL WITH IPAD

- A. Consoles shall be an All Sport[®] 5010 controller and MX-1 Dak Score mobile scoring application from smartphone.

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- B. All Sport® 5010 (Qty. 5)
1. Capable of scoring football, lacrosse, soccer, and field hockey through the use of keyboard inserts.
 2. Controls multiple scoreboards and displays, including other compatible displays currently owned by customer.
 3. Features include:
 - a. Maximum power requirement of 5 watts.
 - b. Ability to recall clock, score, and period information if power is lost.
 - c. A rugged aluminum enclosure to house electronics.
 - d. A sealed membrane water-resistant keyboard.
 - e. A 32-character liquid crystal prompting display to verify entries and recall information currently displayed.
 - f. A 6' (1829 mm) power cord to plug into a standard grounded 120 VAC outlet.
 - g. A 20' (6096 mm) control cable to connect to the control receptacle junction box.
 - h. A practice timer mode:
 - i. Can sound the horn at the end of each segment.
 - ii. Has 99 programmable segments.
 - iii. Displays the segment number and segment length.
 - iv. Has a programmable interval time.
 - i. Carrying case for console.
 - j. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console enclosure and a receiver installed inside the scoreboard.
 - k. Encapsulated Protective Molded PVC external antenna enclosure affixed to control console.
- C. MX-1 Mobile Scoring Control (Qty. 5)
1. Portable control shall allow function of the scoreboard including electronic changeable captions from any location on site (i.e. bleachers, playing field, etc.).
 2. Controls multiple scoreboards and displays, including other compatible displays currently owned by customer.
 3. Outdoor weather-sealed mounting enclosure.
 4. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console enclosure and a receiver installed inside the scoreboard.
 5. Mobile app shall be downloadable to any Apple or Android phone or tablet.
- D. All Sport Pro Full Scoring Control Software (Qty. 2)
1. Modern interface allows wireless control from the field via provided touchscreen tablet.
 2. Assign common or custom rule profiles to fit the level of play.
 3. Display Software Hot Buttons.

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4. Manually play content directly from the Scoring Control Software.
5. Automatically play content via game triggers, such as when a team scores.
6. Multiple data outputs control fixed-digit scoreboards and send RTD to video displays.
7. Create custom color schemes for different teams/operators.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. All power and control cables to scoreboards and displays will be routed in conduit, power to the scoreboards/displays as well as raceways shown on electrical plans by the Electrical Contractor. Scoreboard control wiring (fiber for video display) including conduit, will be the responsibility of the Site Contractor assigned the scoreboard equipment.
- B. Install scoreboards and exterior displays to beams in location detailed and in accordance with manufacturer's instructions. Verify units are plumb and level.

3.3 INSTALLATION—CONTROL CENTER

- A. Provide boxes, cover plates and jacks in locations per plans.
- B. Test connect control unit to all jacks and check for proper operation of control unit, scoreboard and all features. Leave control unit in carrying case and other loose accessories with Owner's designated representative.
- C. Verify earth ground does not exceed 15 ohms.

3.4 CLEAN UP

During the contract and at intervals as directed by the Architect and as scoreboard installation is completed, clear the site of all extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323007

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SECTION 323008 – DUGOUT(S)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all equipment and materials, and do all work necessary to furnish and install the dugouts, as indicated on the drawings and as specified herein. Dugouts shall include, but not be limited to:

1. Modular Dugouts

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Examine contract documents for requirements that affect work of this section. Other specification sections that directly relate to the work of this section include, but are not limited to:

1. Section 312201 – Earthwork
2. Section 321301 – Site Concrete Work
3. Section 323101- Vinyl Chain Link Fence, Backstops, and Gates

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Sports Builders Association (ASBA)
2. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Provide Manufacturer's Product Data and Shop Drawings for the following:

1. Modular Dugouts

- B. Shop Drawings and Design Calculations:

1. Shop drawings and design calculations for the dugout and footings shall be submitted for review by the Architect. The calculations shall bear the seal and signature of a licensed New York State professional engineer and shall present an analysis that will indicate the structural members and footings are of sufficient strength to support the design loads. This analysis shall also indicate that the structural members are able to resist deformations caused by such design loads to which they may be subjected, without exceeding the allowable stresses of the materials. These calculations shall also note additional structural members needed and any modifications to the footings. Any changes will be at no additional cost to the Owner.

1.5 JOB CONDITIONS

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- A. All job conditions in Section 312201 apply.
- B. Verify site location of dugout(s) and locate all underground utilities. Visit site as described in Section 311201.
- C. NY State Professional Engineer (PE) employed by the dugout manufacturer/contractor will determine soil bearing capacity of on site soils from provided soil boring, pit information, and additional testing as the PE deems necessary. The PE is solely responsible for design interpretations and subsequent design of the dugout(s) and its structural footings and foundations.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

1.7 WARRANTY

- A. Dugouts are covered by a Five Year Manufacturer’s Warranty based on Date of Delivery.

PART 2 - PRODUCTS

2.1 PRE-ASSEMBLED MODULAR DUGOUTS

- A. ‘Linkup’ Modular Dugouts as manufactured by:

Poligon
Porter Corp.
4240 N. 136th Ave.
Holland, MI 49424
p. 800-354-7721
www.poligon.com

- B. Design Criteria:

Maximum Wind Speed: 130 mph
Maximum Ground Snow Load: 70 psf
Seismic = S_s=150%, S₁=75%

- C. Components:

- 1. Pre-Assembled Dugout Fabricated from Structural Steel:

- a. Overall Dimensions: 10’ x 36’
- b. Column(s) constructed of 3½” Round Tube for integration with vinyl chain link fencing.

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- c. Roof frame constructed of 3½” x 3½” x 3/16” Square Perimeter and Traverse Tubes & 3” x 2” x 14 Gauge Rectangular Longitudinal Tubes.
 - d. Structural steel members, posts, and purlins powder-coated black, using powder coating with “e-coat”.
2. Roof Type:
- a. Shall be standing seam metal roofing using a series of clips that are covered in a lapping seam system to attach the roof.
 - b. Provide a T and G Wood Roof deck of nominal 2x6 tongue and groove lumber screwed into place. Contractor to seal the wood, in the field, with and Architect approved weather resistant sealer.
 - c. Provide #30 roofing felt with the roofing package.
 - d. Color will be by the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUGOUTS

- A. All dugouts shall be installed as recommended with manufacturer's written directions, and as indicated on the drawings.
1. Footing Requirements:
- a. Install column embedded into the concrete footing as detailed by manufacturer/Contractor Engineer.
2. Poured Concrete Slab:
- a. Overall Dimensions vary with dugout dimensions.
 - b. 4,500 psi concrete slab should extend approximately 6” beyond the columns on all sides.
 - c. Slab shall be poured “over” column concrete footings.
 - d. Concrete slab to be reinforced and poured based on local building codes and soil conditions as verified by architect or owner.
 - e. Additional site work or footings may be required by local codes.

END OF SECTION 323008

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SECTION 323009 – WOOD SCREEN FENCE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of wood screen fence is shown on the drawings.
- B. Wood elements work includes, but is not limited to, the following:
 - 1. Wood Screen Fence and Gates
- C. Provide materials, labor, equipment, and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 321301 - Site Concrete Work

1.3 SUBMITTALS

- A. Required submittals are:
 - 1. Color chip for stain
 - 2. Shop drawing and MPD for wood screen fence and guide rail
 - 3. Fasteners and hardware: MPD

1.4 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. Construction Review: Notify the Architect when wood elements are coordinated to avoid utilities and marked or staked out in the field ready for review.

PART 2 - PRODUCTS

2.1 LUMBER

- A. Wood Screen Fence and Gates: No. 1 grade Western Red Cedar. All wood enclosure boards (1" x 6"), (2" x 4") and (2" x 6") shall be in accordance with ASTM F537.

2.2 CONNECTORS AND FRAMING: Shall be new, first quality and commercially manufactured as follows:

- A. Wood Screen Fence:
 - 1. Line, Corner and End Posts: For 6'-0" wood fence enclosure, heavy "C" posts 2.25" x 1.70" with a minimum bending strength of 351 pounds under a 6' cantilever load continuous coated with 4 oz. of zinc per ft.². Post spacing not to exceed 8 ft. on center. Provide spacing as shown on the drawings. All posts are

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manufactured in the United States, from steel produced and melted in the United States.

2. Line, Corner and End Brackets: All brackets utilized for this application shall be produced of steel and are complete with all the necessary bolts and nuts already attached and are adjustable both vertically and horizontally. The fittings are galvanized in accordance with ASTM-F626. All other fence hardware for wood fencing shall be as outlined in ASTM-F1222.
3. Standard of quality shall be "C" Section Fencing Framework as manufactured by Gregory Industries, Inc., (330) 477-4800, www.gregorycorp.com or Architect approved equal.

2.3 STAIN: Shall be Minwax or Pratt and Lambert or Architect approved equal. Color as selected by the Architect.

2.4 GRANULAR BACKFILL: Shall be as specified in Section 311201, Part 2.

2.5 CONCRETE: Shall be 4,500 psi as specified in Section 321301, Part 2.

PART 3 EXECUTION

3.1 INSTALL WOOD SCREEN FENCE

- A. Set "C" channel posts in concrete footing as detailed. Field verify all measurements prior to setting. Notify Architect of any discrepancy immediately.
- B. Posts and Brackets: The "C" post is installed with the open channel facing out to accept the metal brackets. No drilling or welding is needed. Just slide the bracket in place along the channel and tighten the bolt, locking the bracket in place. The design allows the bracket to adjust vertically and horizontally, allowing the fence to follow the slope of the terrain.
- C. Install Wood Rails: The 2x4 wood rails are butted up to the "C" posts when installed, because the 2x4 rails are the same thickness of the "C" post.
- D. Attach Fence Boards: Cover the "C" post and metal bracket system with fence boards and cover the "C" post on the inside line of the fence with a fence board.

3.2 CLEAN UP

During the contract and at intervals as directed by the Architect and as wood elements are completed, clear the site of extraneous wood, fasteners, coarse sand, asphalt and debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323009

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SECTION 323101 - VINYL CLAD CHAIN LINK FENCE, BACKSTOPS, AND GATES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of vinyl clad chain link fence is shown on the drawings and includes, but is not limited to, the following:
 - 1. New vinyl clad chain link fence and gates.
 - 2. Backstops with canopy.
 - 3. Fence guard
- B. Provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 321201 - Asphalt Paving
- B. Section 321301 - Site Concrete Work

1.3 SUBMITTALS

- A. Manufacturer's Product Data: Manufacturer's catalog cuts indicating material compliance and specified options.
- B. Shop Drawings: For fence, backstops, and gates including plan layout and details illustrating fence heights, location and sizes of posts, finishes, rails, braces, and installation procedures. Provide footing sizes and hardware list.
- C. Sample: 4" line post with specified vinyl coating.
- D. Fence Guard for all 4'-0" Chain Link Fence: MPD

1.4 JOB CONDITIONS

- A. All job conditions in Section 312201 apply.
- B. Construction Review: Notify the Architect when fence and gates are staked out.

PART 2 - PRODUCTS

2.1 CHAIN LINK FENCE

- A. General: Shall conform to Chain Link Fence manufacturer's Institute specifications. See drawings for sizes and weights of posts and fabric. All posts, rails, fittings, fabric and tension wire shall be vinyl coated galvanized steel, painting will not be acceptable. Standard of quality shall be Colorbond II, Class 2b as manufactured by Merchant Metals, 888-260-1600 or Architect approved equal. Color shall be black unless otherwise shown on the drawings.

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- B. Chain Link Fabric: The base metal of chain-link fabric is composed of commercial quality medium high carbon, hot-dipped galvanized steel wire. The vinyl coating is securely fused over the galvanized steel wire by the Thermal Fusion process under pressure to 5000 psi to insure a dense and impervious covering free of voids, having a smooth and lustrous surface appearance. The vinyl coating thickness, zinc coating weight, and wire tensile strength conforms to ASTM F668 Class 2B, Federal Specifications RR-F-191/1C. The wire shall be vinyl clad before weaving and is free and flexible at all joints. The mesh is measured by the distance between the wires forming parallel sides of the mesh. The height of the fabric, measured from the ends of the knuckles, has a permissible variation of plus or minus one inch. Fabric is knuckled at both selvages (top and bottom).

Usage	Mesh Size	Break Load of Wire	Thermally Fused -Vinyl Coated Core Wire Gauge
Standard	2" (50 mm)	1290 lbF	9 ga. [0.148" (3.76 mm)]
Backstop Reinforcement	2" (50 mm)	2170 lbF	6 ga. [0.192" (4.88 mm)]

- C. Wire Coating: Only Plasticized Polyvinyl Chloride (PVC) with low temperature (-20 degrees C.) plasticizer, no fillers, extenders or extraneous matter, other than the necessary stabilizers and pigments are used. Colors are stabilized and have a light fastness that withstands a minimum WEATHER-O-METER exposure of 4,000 hours without any deterioration (Test Equipment Operating Light and Water Exposure Apparatus Carbon-Arc Type) ASTM-D 1499. The vinyl covering, in addition, resists attach from prolonged exposure to diluted solutions of most common mineral acids, sea water and diluted solutions of most salts and alkali.
- D. Standard Munsell Color System: All fabric, posts and fittings comply with the Munsell Color System as indicated: Black N.1.1.7/0.
- E. Framework: Line, corner and terminal posts, top, bottom and intermediate rails are Type 1 Schedule 40 hot-dipped galvanized steel to ASTM F 1083 or high yield galvanized steel pipe with a 14 mil vinyl coating bonded to a special crosslinking epoxy primer by the Thermal Fusion process.
- F. Top, Intermediate and Bottom Rails: Top rail is thermally fused vinyl coated galvanized steel pipe in 21 foot lengths jointed by 6 inch long sleeves, vinyl clad, to run continuously along top of fence. Bottom and intermediate rails, if required, conform to specifications for top rail and are jointed at line posts with vinyl clad boulevard clamps.
- G. Line Posts: Liner posts are thermally fused vinyl coated galvanized steel pipe. Posts are sufficient length to allow for installation as detailed and are spaced in the line of fence not farther apart than 10 feet. The fabric is fastened to the line posts by means of matching 9 gauge, vinyl coated ties.
- H. Terminal Posts: Corner and terminal posts are thermally fused vinyl coated galvanized steel. Each post is of sufficient length to allow for a depth as detailed. Fabric is attached to the terminal post by means of vinyl coated tension bars and held by vinyl coated

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tension bands. Corner posts are placed at each change in direction or as directed by the engineer. All corner and terminal posts are braced with vinyl-clad galvanized steel 1.66 inch O.D. brace, rail, 10 feet long, with a diagonal 3/8 inch diameter truss rod, and attached to the first adjacent line post.

- I. Gates: Gate frames are made of thermally fused vinyl coated galvanized steel pipe, jointed at the corners using specially designed corner fittings or welded to form a rigid panel. Frames are filled with the same gauge fabric as the fence. The fabric is fastened in the frame on all sides by means of vinyl coated fasteners and tension bars.
- J. Fittings: Fittings and other appurtenances are of aluminum alloy, galvanized pressed steel, malleable or cast steel as specified, epoxy-phenolic primed and coated with matching vinyl (PVC) by the fusion-bond method. Painted fittings are not acceptable.
- K. Tie Wires: Tie wires are 8 gauge O.D. vinyl clad galvanized steel wire installed at 1'-0" intervals.
- L. Nuts and bolts are galvanized but not vinyl coated. Provide PVC touchup paint to color coat nuts and bolts.
- M. Concrete Footings: Shall be 4000 psi as specified in Section 321301, 2.1.

2.2 FENCE GUARD

- A. Shall be premium grade, 3" wide x 4 ½" high, and wall thickness of .10.
- B. Constructed of heavy duty, UV resistant polyethylene. Color selected by Owner.
- C. 5-year Limited Warranty.
- D. Basis of design and standard of quality shall be Premium Fence Guard as distributed by Sportsfield Specialties, Inc., 888-975-3343, or Architect approved equal.
- E. This system is required for the entire ball field(s) 4'-0" fence. All fields.

PART 3 - EXECUTION

3.1 INSTALL CHAIN LINK FENCE

- A. Locate per plan and install in accordance with Chain Link Manufacturer's Institute specifications.
- B. Do not begin fence installation and erection before the final grading is completed, with finish elevations established, unless otherwise permitted.
- C. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.
 - 1. Excavate hole depths as detailed when in firm, undisturbed soil. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.

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2. Spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site, as directed.
- D. Setting Posts: Remove all loose and foreign materials from sides and bottoms of holes.
1. Center and align posts in holes. Install posts plumb, in neat, straight lines, and with minimal waviness of top railing.
 2. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 3. Trowel finish tops of footings, and dome surface to direct water away from posts. Extend footings for gate posts to the underside of bottom hinge.
 4. Keep exposed concrete surfaces moist for at least 7 days after placement, or cure with membrane curing material, or other acceptable method.
- E. Concrete Strength: Allow concrete to attain at least 75% of its minimum 28-day compressive strength, but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire, or fabric is installed. Do not stretch and tension fabric and wires, and do not hang gates until the concrete has attained its full design strength.
- F. Truss Rod: Install truss rod so posts are plumb when diagonal rod is under proper tension.
- G. Fabric: Leave approximately 1½" between finished grade and bottom selvage. Place fabric on play side of posts in play areas and security side of posts in non play areas. Anchor to framework so that fabric remains in tension after pulling force is released.
- H. Repair damaged coatings in the shop or during field erection by recoating with hot applied repair compound, applied per manufacturer's recommendations.
- I. Tie Wires: Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing. Install 1'-0" o.c.
- J. Fasteners: Install nuts for tension band and hardware bolt on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts. Paint all exposed surfaces with black PVC touch up paint.

3.2 FENCE GUARD

- a. Install as recommended by the manufacturer.

3.3 CLEAN UP

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- A. During the contract and at intervals as directed by the Architect and as chain link fence and gate installation is completed, clear the site of all extraneous concrete, gravel, asphalt or debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323101

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SECTION 323102 - POLE TO POLE TENSION NETTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of pole to pole tension safety netting backstop is shown on the drawings and includes, but is not limited to, the following:
 - 1. Poles
 - 2. Wire rope support structure
 - 3. Netting
- B. Provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 321301 - Site Concrete Work
- C. Section 323102 - Vinyl Clad Chain Link Fence and Gates

1.3 REFERENCES

- A. Comply with applicable requirements for the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Federation of State High School Associations (NFHS)
 - 2. International Association of Athletics Federations (IAAF)
 - 3. American Sports Builders Association (ASBA)
 - 4. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Provide Qualification Experience requirements as specified in "Quality Assurance" of this section. Provide a list of completed projects including Owner contact information.
- B. Manufacturer's Product Data (MPD): Manufacturer's catalog cuts indicating material compliance and specified options.
- C. Shop Drawings: Provide drawings of the manufacturers recommended installation and foundation requirements prior to actual field installation work, for Architect or Owner representatives review. Provide footing sizes and hardware list. Footings and steel detailing shown on the drawings shall not be reduced in size.
- D. Samples: 6" x 6" section of netting

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- E. Netting Footing and Steel Shop Drawings stamped and signed by the Contractor's Professional Engineer licensed in New York State.

1.5 JOB CONDITIONS

- A. All job conditions in Section 312201 apply.
- B. Construction Review: Notify the Architect when fence and gates are staked out.

1.6 QUALITY ASSURANCE

- A. Manufacturers warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements. The Manufacturer shall have a current American Sports Builders Association (ASBA) Supplier Certificate of Distinction designation.
- B. Manufacturer: Company having manufacturing facilities in the United States with five (5) years experience specializing in manufacturing of tension netting products.
- C. Pole to Pole Tension Netting Contractor: Contractor having five (5) years experience installing similar projects in accordance with ASTM F567.
- D. Tolerances: ASTM current specification and tolerances apply and supersede any conflicting tolerance.
- E. Single source: To ensure system integrity obtain the netting system, framework, fittings, and accessories from a single source.
- F. NYS Engineer qualifications: The pole-to-pole tension netting design, construction, and installation, shall be approved by the Contractor's registered NYS licensed professional engineer.

1.7 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage and defect in shipping. Any defects shall be noted and reported to the Owners representative. Replacement, if necessary, shall be immediately reordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

1.8 WARRANTY

- A. Provide manufacturer's standard limited warranty that its safety netting is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of one (1) year from the date of installation.

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PART 2 - PRODUCTS

2.1 POLE TO POLE TENSION NETTING SYSTEMS

- A. Base: TNPPUC- Pole-to-Pole Tension Ball Netting System with Ultra Cross Netting as manufactured and/or supplied by:

Sportsfield Specialties, Inc.
P.O. Box 231
41155 State Highway 10
Delhi, NY 13753
p. 888-975-3343
f. 607-746-8481
www.sportsfieldspecialties.com

or Architect approved equal.

- B. Components:

1. Pole-to-Pole Tension Ball Safety Netting System Upright Support Posts and Pole Structures - Fabricated, Sized and Configured as Required:
 - a. Post and Netting Height above finish grade required:
 - 20' for multi-purpose turf field, as shown on the plans.
 - 30' for the property line edge, as shown on the plans.
 - b. Powder coated finish (black to match fencing)
 - c. Permanent embedment mount with stamped foundation design as required
 - d. Hot dipped galvanized assembly hardware - quantities, sizes and configurations as required
 - e. 4" Schedule 40 steel posts, single piece design for 20' netting
10" Schedule 40 steel posts, single piece design for 30' netting
 - f. 600' lf +/- of 20' high netting required.
540' lf +/- of 30' high netting required.
2. Pole-to-Pole Tension Ball Safety Netting System Wire Rope Support Structure:
 - a. Length, height and configuration as required.
 - b. 7 x 19 GAC Galvanized Aircraft Cable - 5/16" diameter main horizontal support, 9,800 lb. minimum breaking strength, 3,267 lb. minimum working load limit.
 - c. 7 x 19 GAC Galvanized Aircraft Cable - 1/4" diameter vertical and bottom horizontal support, 7,000 lb. minimum breaking strength, 2,333 lb. minimum working load limit.
 - d. Hot dipped galvanized attachment and assembly hardware - quantities, sizes and configurations as required.
3. Pole-to-Pole Tension Ball Safety Netting System Net and Rope Bound Border:
 - a. Length, height and configuration as required

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- b. Ultra cross knotless netting
 - c. Dyneema Ultra-High Molecular Weight Polyethylene (UHMWPE) SK-75 Back Fiber Construction
 - d. 4 Ply, 1.2 mm (0.0472") diameter twine
 - e. 95% open mesh area (see-through visibility)
 - f. 58,445 psi minimum breaking strength
 - g. 30% maximum elongation at break
 - h. 1-3/4" (44 mm) square mesh size, 0.009 lbs. per square foot
 - i. 4-strand, braided, continuous monofilament Dyneema Fiber
 - j. Black multi-filament polypropylene solid braid derby rope sewn binding on perimeter edges - 1/4" diameter, 530 lb. minimum breaking strength
 - k. Urethane black bonded finish
 - l. Strong resistance to ultraviolet (UV) light degradation
 - m. Excellent resistance to chemicals and water absorption
 - n. Shall have storm guard release capability.
4. Included Accessories:
- a. Hot dipped galvanized attachment and assembly hardware - quantities, sizes and configurations as required
 - b. Black multi-filament polypropylene solid braid rope for net binding attachment to wire rope support structure - 1/4" diameter, 530 lb. minimum breaking strength - quantities and configurations as required.
 - c. Stamped and sealed drawings and calculations by a licensed Professional Engineer of Record in the State of New York
- C. Color System: All posts, rails, fittings, fabric, hardware, and tension bars shall be black in compliance with ASTM F934.
- D. Standard of quality: shall be Color Bond II, Class 2b as manufactured by Merchant Metals, (888) 260-1600 or Architect approved equal.

2.2 CONCRETE FOOTINGS

- A. Shall be 4,500 psi as specified in Section 321301, 2.1.

PART 3 - EXECUTION

3.1 SITE EXAMINATION AND PREPARATION

- A. Ensure property lines and legal boundaries of work are clearly established (by the Site Contractor)
- B. Survey and field verification of backstop and dugout location to be provided by Site Contractor.
- C. Clearing: The Site Contractor shall clear, grub and remove vegetation/debris for the backstop installation area.

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- D. Verify areas to receive backstop are completed to final grade with finished elevations shown on the drawings.

3.2 NETTING FRAMEWORK INSTALLATION

- A. Locate posts.
- B. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.
 - 1. Excavate hole depths as detailed when in firm, undisturbed soil. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
 - 2. Remove soil excavated from site.
- C. Setting Posts: Remove all loose and foreign materials from sides and bottoms of holes.
 - 1. Center and align posts in holes. Install posts plumb, in neat, straight lines, and with minimal waviness of top railing.
 - 2. Install reinforcing bars as indicated.
 - 3. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 - 4. Top of footing shall meet elevation as indicated on drawings so that grade beam can be placed over as shown.
 - 5. Keep exposed concrete surfaces moist for at least 7 days after placement, or cure with curing material, or other acceptable method.
- D. Concrete Strength: Allow concrete to attain at least 75% of its minimum 28-day compressive strength, but in no case sooner than 7 days after placement, before rails, tension bands or fabric is installed. Do not stretch and tension fabric and wires, and do not hang gates until the concrete has attained its full design strength.
- E. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- F. All Pole-to-Pole Tension Ball Safety Netting Systems with Ultra Crossing and Accessories shall be installed as recommended per manufacturer's written instructions and as indicted on the drawings.

3.3 CLEAN UP

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- A. During the contract and at intervals as directed by the Architect and as netting, backstop and post installation is completed, clear the site of all extraneous concrete, gravel, fence material or debris. Leave the site in a clean, safe, well draining, neat condition.

END OF SECTION 323102

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SECTION 329001 - PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of planting is shown on the drawings.
- B. Planting work includes, but is not limited to, the following:
 - 1. Soil preparation
 - 2. Planting commercially grown trees, shrubs, and perennials ground covers.
 - 3. Planting accessories
 - 4. Maintenance: See watering, weed control and other specific requirements
 - 5. Guarantee
 - 6. Clean up
- C. The Contractor shall provide materials, labor, equipment, and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 329201 - Seeded and Sodded Lawns

1.3 SUBMITTALS (See Section 311201, 1.5)

- A. Furnish name of Landscape Contractor and/or Nurseryman to perform planting work and obtain Architect's approval.
- B. Provide Material Certificates, MPD, Test Reports or Samples as noted for:
 - 1. Mulch: Twelve (12 oz.) ounce sample
 - 2. Planting Soil Mixture: Material Certificate and Test Report. See 1.4 F.
 - 3. Plant Materials: Certificates of Inspection by regulatory agencies. Leave tags with botanical names and nursery source(s) on plants until reviewed by Architect.

1.4 QUALITY ASSURANCE

- A. Perform planting in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Planting Contractor: Planting work by established Landscape Contractor and/or Nurseryman having sufficiently experienced crews, supervisor(s), specialized equipment and an excellent record of performance on completed planting projects of comparable size, scope, and quality. Provide expert plantsman to direct the work in the field on a regular, daily basis.

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- C. Nomenclature: Plant names shall conform to the latest edition of "Standardized Plant Names" as adopted by the American Joint Committee of Horticultural Nomenclature. Plants shall be true to botanical name, tagged with a waterproof, legible tag showing botanical name, size, and nursery source of origin.
- D. Size and Grading: Plant sizes and grading shall conform to the latest edition of "American Standard for Nursery Stock" as sponsored by the American Association of Nurserymen, Incorporated (AAN), latest issue unless otherwise specified.
- E. Nursery Source: Obtain freshly dug, healthy, vigorous, plants nursery grown under climatic conditions similar to those in the locality of the project for a minimum of two (2) years. Plants shall have been lined out in rows, annually cultivated, sprayed, pruned, and fertilized in accordance with good horticultural practice. Plants shall have been transplanted or root pruned at least once in the past three years. Balled and burlapped plants must come from soil which will hold a firm root ball. Heeled in plants and plants from cold storage not accepted.
- F. Testing:
 - 1. Engage an independent, qualified State of New York soil testing service. Pay for soil testing and inspection services.
 - 2. Test representative material samples proposed for use as follows:
 - a. Planting Soil Mixture
 - (1) pH factor
 - (2) Mechanical analysis
 - (3) Percentage of organic content
 - (4) Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.
 - b. Peat Moss
 - (1) Loss of weight by ignition
 - (2) Moisture absorption capacity

1.5 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. Planting seasons and timing conditions:
 - 1. Unless otherwise directed in writing by the Architect, the planting of trees, shrubs, and perennials shall be from in the Spring, March 15 to June 1, and in the Fall, from October 15 to December 15. Refer to 1.5 Fall Planting Hazard restrictions below.

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2. Proceed with and complete planting work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.
3. Do not conduct planting operations until fine grading in the work areas has been completed satisfactorily.
4. Cooperate with other Contractors and trades working in and adjacent to planting locations. Examine drawings and specifications for the entire site and become familiar with the scope of other work required, especially underground utilities.

C. Construction Review:

1. Plants must be reviewed by the Architect before planting, either at the site or at the nursery.
2. Notify the Architect forty-eight (48) hours prior to delivery of plant materials to the site.
3. Plants not meeting specifications or not installed according to drawings may be rejected at any time by the Architect.

D. Provide plants of the species, size, and special characteristics noted on the Plant List. Substitutions not permitted unless approved in writing by the Architect. In the event that quantity discrepancies or material omissions occur in the Plant List, the planting drawings shall govern.

E. Owner shall furnish water at the building face(s). Contractor shall provide labor, hoses, sprinklers and watering equipment.

F. Fall Planting Hazard (FPH):

1. Notify the Architect in writing when any of the proposed plants are sensitive to fall planting in the experience of the Contractor. Plant materials noted as FPH in the PLANT LIST shall be planted in the Spring season. Assume sole responsibility of plant health related to materials noted FPH which are fall planted. Replace unhealthy or dead plants as described in the Guarantee.
2. Plants considered very risky to transplant in the fall include, but are not limited to, the following; (based on information obtained from Princeton Nurseries, Fall 2001- Spring 2002 catalog and experience of the Landscape Architect)

Acer rubrum & vars.	Platanus acerifolia
Betula varieties	Prunus - Stone fruits
Carpinus varieties	Pyrus - Pears
Cornus florida & vars.	Quercus - Oaks
Crataegus varieties	Salix - weeping vars.
Halesia	Strax japonica
Koelreuteria	Tilia tomentosa
Liquidambar styraciflua	Zelkova varieties

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Liriodendron tulipifera Pinus nigra

3. Evergreen plant materials are also considered a fall planting hazard.

PART 2 - PRODUCTS

2.1 PLANTS

- A. Plants shall be well formed without voids and open spaces, typical of their species or variety, with normal habit of growth. Plants shall be first quality, sound, healthy, vigorous, well branched and densely foliated. Plants shall have healthy, well developed fibrous root systems. They shall be free of defects, disfiguring knots, sun-scald injuries, frost cracks, abrasions, disease, insect pests, eggs, and larvae.
- B. Plants shall conform to the measurements specified in the Plant List. Measurements specified shall be minimum size acceptable for each variety. For each plant of minimum size, provide a plant of maximum size. Plants that meet the requirements specified in the Plant List, but do not possess a normal balance between height and spread will not be accepted. Plants for use when symmetry is required, or in rows, shall be matched as nearly as possible. Plants shall not be pruned prior to delivery.
- C. Plants and tree trunks shall be measured when the branches are in their normal position. Dimensions for height and spread as contained herein refer to the main body of the plant and not from branch-tip to branch-tip. Shade trees shall be free of branches up to seven feet, with a single leader, well branched and reasonably straight stems. No trees which have had their leaders cut or damaged will be accepted. Trees must have straight trunks with single leader intact. There shall be no abrasion of the bark and no fresh cuts of limbs over one (1") inch which has not been completely calloused over.
- D. Balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock." Cracked or mushroomed balls are not acceptable.
- E. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.
 1. No plants shall be loose in the container.
 2. Container stock shall not be pot bound.
- F. Bare-root plants dug with adequate fibrous roots, covered with a uniformly thick coating of mud by being puddled immediately after they are dug, or packed in moist straw or peat moss.
- G. Evergreen trees shall be fully branched to the ground. (Park Standard)

2.2 PLANTING ACCESSORIES

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- A. Planting soil mixture for trees, shrubs, perennials, annuals and plant beds shall be premixed in bulk, and contain the following by volume:

20 parts clean on site soil
10 parts topsoil
- B. Topsoil: 5-10% organic, 20-65% passing 200 mesh sieve. Fertile, friable, natural topsoil of leafy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sand, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 6.5 and 7.5, free of substances harmful to plants which will be grown in the soil.
- C. Starter Fertilizer: Water soluble fertilizer and plant food 10-52-17 containing no sulfate or chloride salts. Standard of quality shall be as manufactured by Fairlawn Chemical Co., Inc., 485 Holt Road, Webster, NY (585) 671-2400, and distributed by Organix, 569 Klem Road, Webster, NY (585) 787-2711 or Architect approved equal.
- D. Peat Moss: Brown to black in color, weed and seed free, dried sphagnum peat moss, containing not more than 9% mineral on a dry basis and conforming to NYSDOT 713-20.
- E. Stakes: Minimum eight (8') foot long, two (2") inch round or square sound wood stakes.
- F. Hose: New, two (2) ply garden hose not less than one-half (1/2") inch in diameter.
- G. Guy Wire: 10 gauge galvanized steel wire for guying plantings where specified.
- H. Tree Wrap: Standard of quality shall be four (4") inch wide waterproof 30-30-30 Krinklecraft, or Architect approved equal.
- I. Mulch:

Ground or shredded bark, medium size, from softwood trees. No pieces over two (2") inches in greatest dimension. Free from sawdust, stones, debris, and deleterious materials.
- J. Anti-desiccant: Standard of quality shall be "Wiltpruf" or Architect approved equal.
- K. Plant Bed Edging: Shall be polyvinyl commercially manufactured edge. Standard of quality shall be as manufactured by Oly-Ola Sales, Inc., Villa Park, IL (Tel. 1- 800- EDGINGS) or Architect approved equal.
- L. Weed Control Fabric: 4.1 oz. needle woven punched fabric. DeWitt Weed Barrier or Architect approved equal.

PART 3 - EXECUTION

3.1 **LAYOUT:** Locate and stake in the field individual trees, shrubs, and plant beds for approval by the Architect prior to commencing planting operations.

3.2 **GENERAL PLANTING OPERATIONS**

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- A. Transportation and Handling: Take precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants to foliage with an approved "Anti-Desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Do not hold or move trees by stems. Support and protect root balls.
- B. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be filed with the Architect.
- C. Protect plants from drying out. When plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the Architect. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches. Cover plants transported on open vehicles with protective covering to prevent wind burn. Do not hold or move trees by stems. Support and protect root balls.
- D. Provide dry, loose prepared planting soil for planting bed mixes. Frozen or muddy soil is not acceptable.
- E. Excavate tree pits, shrub and planting beds as dimensioned and located on drawings. When soils harmful to plant materials are encountered, immediately notify the Architect.
- F. Plants shall be set plumb and straight and at such a level that after settlement, a normal or natural relationship of the crown of the plant with the ground surface will be established. Each plant shall be planted in the center of the pit. When balled, burlapped, and platformed plants are set, the platform shall first be removed from the pit and topsoil shall be carefully tamped under and around the base of each ball to fill voids. Burlap, ropes, and wires shall be removed from the sides and tops of balls, but no burlap shall be pulled out from under the balls.
- G. Plants shall be planted in the planting soil mixture which shall be thoroughly watered and tamped. On level ground or slight slopes, a shallow basin a little larger than the diameter of the plant pit shall be left around each plant as shown on the drawings or as directed by the Architect. On steep slopes, the soil on the lower side of the plant shall be graded in such a manner that it will catch and hold water as shown on the drawings or as directed by the Architect.
- H. Staking: Trees two (2") inch caliper or less shall be staked with two stakes. The trunks of trees larger than two (2") inches shall be staked with three stakes, equally spaced about the tree, set vertically and securely fastened. The trees shall be guyed with two or three strands of wire as specified, which shall run through the rubber hose and be securely tightened.
- I. Install weed control fabric over the planting area to limits indicated or as directed by the Architect. Cut fabric as required to avoid shrubs.
- J. Mulching: Spread continuous four (4") inches settled depth of mulch over finished surface of each plant, plant bed, or hedge trench as detailed. Water plants thoroughly

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after mulching. NOTE: The Architect may field check depth of mulch for proper weed control barrier since no weed control fabric is required.

- K. Wrap deciduous trees with tree wrap to first branch and secure wrap.
 - L. Pruning: Each shrub or tree shall be pruned to preserve the natural character of the plant. Remove dead wood and crossing branches. Do not prune terminal leaders. Refer to drawings for additional tree pruning details.
 - M. Anti-Desiccant: Immediately after planting and staking, trees and shrubs shall be sprayed with anti-desiccant, using an approved power sprayer to apply an adequate film over trunks, branches, twigs, and/or foliage. Apply according to manufacturer's recommendations.
 - N. Replacements: Remove and immediately replace plants, as determined by the Architect, to be unsatisfactory during the initial planting installation.
- 3.3 PLANT PERENNIALS: Rototill entire bed prior to planting. Rake surface smooth and remove stones one (1") inch and greater. Remove plants from pots or flats and plant immediately in prepared planting soil. Water thoroughly. Place four (4") inches continuous settled depth mulch over entire bed.
- 3.4 INSTALL EDGE: When shown on drawings according to manufacturer's recommendations.
- 3.5 MAINTENANCE
- A. Maintenance by Contractor begins as soon as plants are installed. Protect plants from drought, washout and wind erosion. In general, maintain new plantings, including watering, weeding, pruning, applications of herbicides, fungicides, insecticides and pesticides, until healthy, vigorous plants are accepted by the Architect. Specifically:
 - 1. Protect: Protect plantings against harsh weather, trespass and vandalism by wrapping, staking, temporary fencing or other means.
 - 2. Water: The Owner shall furnish water at the building face(s). The Contractor shall provide labor, hoses, sprinklers and watering equipment to maintain plants, prevent them from drying (browning) out, and keep plants in a healthy, growing condition until final acceptance.
 - 3. Cultivate: Cultivate plants by straightening any settled plant materials, restaking and guying, rewrapping, pruning dead and broken branches, weeding and re-applying anti-desiccant, herbicide, fungicide, insecticide and pesticide.
 - 4. Should the Contractor fail to protect and maintain the plantings, the Owner may issue a three (3) day notification to the Contractor, hire work done, and backcharge this Contractor.
 - B. Maintenance by the Contractor continues until Certificate of Final Acceptance, or Final Punch List is satisfactorily completed and accepted by the Architect, whichever is later. Maintenance by Owner begins as soon as the Architect issues Certificate of Final

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Acceptance or Final Punch List is satisfactorily completed and accepted by the Architect, whichever is later.

3.6 STANDARDS FOR ACCEPTANCE: Review to determine acceptance of plantings will be made by the Architect upon request. Provide notification at least five (5) working days before requested review date.

- A. New plantings will be acceptable provided requirements, including maintenance, have been complied with. Healthy, well-formed, vigorous plants, true to species and size on Plant List, must be established, free of disease, broken branches and insects.
- B. Any plant which is poorly formed, structurally unsound, not true to species and size on Plant List, diseased, contains broken branches, or is generally unhealthy (containing 25% or more browned out foliage), shall be rejected and replanted at no additional cost to the Owner.

3.7 GUARANTEE

- A. Contractor shall guarantee plant materials to be true to species and size on Plant List, and in vigorous growing condition, for a period of one (1 yr.) year from the date given on the Certificate of Substantial Completion or Final Punch List is satisfactorily completed and accepted by the Architect, whichever is later.
- B. Any plant material that does not meet the Standards for Acceptance shall be replaced as soon as weather conditions permit. Replacement plantings shall be made in accordance with the specifications and drawings. Replacements shall be subject to inspection, acceptance, and guaranteed for one (1 yr.) year after date of replanting and acceptance by the Architect.

3.8 CLEAN UP

During the contract and at intervals as directed by the Architect and as planting is completed, clear the site of extraneous materials, pots, flats, hose, wire, stakes, pruned branches, rubbish, and debris. Leave the site in a clean, safe, neat, well draining condition.

END OF SECTION 329001

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SECTION 329201 - SEEDED AND SODDED LAWNS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the lawn work is shown on the drawings. The lawn work limits equal the Contract Limit Line except as noted on the drawings. Non-paved, non-roofed areas within the Contract Limit Line shall receive four (4") and six (6") inches settled depth of topsoil and lawn seed or sod. Existing lawn areas that are not disturbed require no additional work.
 - 1. Lawn Type 1: Strip and stockpile topsoil, remove debris, replace 4" topsoil, and sod.
 - 2. Lawn Type 2: Strip and stockpile topsoil, add onsite or offsite topsoil, screen, blend with compost, replace 6" topsoil, and sod.
 - 3. Lawn Type 3: Strip and stockpile topsoil, remove debris, replace 4" topsoil, seed with wetland mix.

- B. Lawn work includes, but is not limited to, the following:
 - 1. Placing and spreading stockpiled topsoil
 - 2. Importing, placing and spreading topsoil
 - 3. Providing screened topsoil for athletic fields
 - 4. Sod bed preparation and placing
 - 5. Seed bed preparation
 - 6. Temporary striping of athletic fields for planarity verification
 - 7. Seeding and sodding lawns
 - 8. Mulching and fertilizing
 - 9. Straw mat
 - 10. Maintenance: See watering, mowing, fertilizing, core aerating, weed control and other specific requirements.
 - 11. Clean Up

- C. Provide materials, labor, equipment, and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312201 - Site Earthwork
- B. Section 323007 Series - Infield Work
- C. Section 329001 - Planting

1.3 SUBMITTALS: (See Section 311201, 1.5)

- A. Furnish name of Landscape Contractor or Nurseryman to perform lawn work and obtain Architect's approval.

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- B. Provide Material Certificates and MPD for:
1. Sod species and source, location for sod producer
 2. Seed species and source
 3. Limestone
 4. Fertilizers
 5. Hydromulch
- C. Provide Topsoil Test Report: Submit test results from Architect approved independent testing laboratory on their letterhead. Report shall:
1. Certify soil texture and content, pH value, sieve and nutrient analysis.
 2. Provide specific recommendations on liming and fertilizing (nitrogen, phosphate and potash).
- D. Provide letter on Contractor's letterhead certifying that only topsoil from the above tested source was used on the project.
- E. Lawn Seed Mix: Submit one (1 lb.) pound seed sample for each mix specified in vendor's unopened package with label clearly showing the following:
1. Name and address of labeler
 2. Lot number
 3. Kind and variety of turfgrass seed listed in order of predominance
 4. Percent by weight of pure seed of each species and variety (percent purity)
 5. Germination percentage (percent viable seed)
 6. Percent by weight of other crop seed
 7. Percent by weight of weed seed
 8. Percent undesirable grass seed
 9. Percent by weight of inert matter
 10. Date on which the germination test was conducted
- F. Submit seed tags from **ALL** used or partially used seed bags. At times throughout the project, the Architect may request seed samples of onsite seed bags.
- G. Schedule: Prior to construction, provide a schedule which addresses the following lawn thresholds involving erosion control stabilization and competitive use of playfields:
1. Seeding and Sodding Installation: The Contractor may invoice for 50% of the approved schedule of value breakdown at the time of acceptable installation.
 2. Substantial Completion: The Contractor may invoice for 25% of the approved schedule of value breakdown at the time of substantial completion as described in 329201, 3.10. At this time, the Architect may issue the Notice of Termination to satisfy the NYS DEC stabilization requirements. The date of substantial completion is anticipated approximately 60 days after lawn installation presuming all Contractor maintenance operations have been vigorously performed.

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3. Final Acceptance: The Contractor may invoice for the final 25% of the approved schedule of value breakdown at the time of final acceptance as described in 329201, 3.11. The date of final acceptance is anticipated approximately 30 days after substantial completion presuming all Contractor maintenance operations have been vigorously performed.
4. Owner Maintenance: After final acceptance of the lawns, the Owner will maintain for 1 to 3 seasons to reach competitive maturity.

1.4 QUALITY ASSURANCE

- A. Lawn Contractor: Work shall be contracted to a single, established Landscape Contracting or Nursery firm having sufficiently experienced crews, supervisor(s), specialized equipment, and an excellent record of performance on completed lawn projects of comparable size, scope, and quality. Provide expert turfman to direct the work in the field on a regular, daily basis.
- B. Sod Standards: Comply with the American Sod Producers Association (ASPA) class of sod materials.
- C. Nomenclature: Seed names shall conform to the National Turfgrass Federation, Inc.
- D. Seed Quality Rating: Shall meet testing standard outlined by the National Turfgrass Evaluation Program (NTEP).
- E. Delivery, Storage, and Handling: Deliver seed and fertilizer materials in original unopened containers clearly showing weight, analysis by weight and name of manufacturer. Store in cool, dry place in a manner to prevent wetting and deterioration.
- F. Testing: If required by the Architect for sub standard lawn grow in, engage an independent, qualified New York State testing service to evaluate Contractor grow in practices and materials used. Pay for testing and inspection services.

1.5 SOD DELIVERY, STORAGE, AND HANDLING

- A. Cut, deliver, and install sod within a 24-hour period.
- B. Do not harvest or transport sod when moisture content may adversely affect sod survival.
- C. Protect sod from sun, wind, and dehydration prior to installation.
- D. Do not tear, stretch or drop sod during handling and installation.
- E. Store materials at site in an orderly manner at location(s) acceptable to the Architect.

1.6 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. Lawn Seeding:

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1. Unless otherwise directed in writing by the Architect, seed lawns from March 15 to May 15, and from August 15 to September 15. Seeding between May 16 and August 14 is not acceptable unless adequate water supply is available.
 2. Proceed with and complete seeding as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.
 3. Perform seeding after planting, fine grading and other work affecting the ground surfaces in the work areas has been completed satisfactorily.
 4. Provide lawn seed mixes as specified. Substitutions not permitted, unless approved in writing by the Architect.
 5. Provide water, meters, labor, hoses, sprinklers and watering equipment. The Owner will pay for the water usage including trucking if required.
 6. For Lawn Type 3, perform lawn seeding using mechanical and hand seeding methods within ten (10') feet of buildings and pavement edges. Hydroseeding is not permitted within ten (10') feet of buildings and pavement edges. Mechanical, hand operation and hydroseeding is permitted in other lawn areas.
- C. Sod (Lawn Type 1 and 2):
1. Unless otherwise directed in writing by the Architect, sod lawns from March 15 to May 15 and August 15 to November 1. Sodding between May 16 and August 14 is not acceptable unless adequate water supply is available.
 2. Place sod only when ground surface is free of frost.
 3. Proceed with and complete sodding work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.
 4. Perform sodding after planting, fine grading, and other work affecting the ground surfaces in the work areas has been completed satisfactorily.
 5. Provide sod as specified. Substitutions not permitted, unless approved in writing by the Architect.
 6. Provide water, meters, labor, hoses, sprinklers and watering equipment. The Owner will pay for the water usage including trucking if required.
- D. Construction Review:
1. Upon completion of topsoil spreading and sod and/or seed bed preparation, notify Architect to review work.
 2. The Architect may review string graded areas by the Contractor to check for surface smoothness and general compliance with grading requirements. Fill or

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cut by hand raking or other acceptable means to achieve smooth, even well-draining lawn surfaces free of "bird baths" and breaks in grade as directed by the Architect at no additional expense to the Owner.

3. Review by string grading shall not alleviate the Contractor of his responsibility for conforming to the required grades as shown on the drawings, nor be misconstrued as final acceptance of lawn work.
4. On athletic fields the Architect shall review planarity of the field by string grading and by visual inspection of the temporary line markings installed by the Contractor prior to seeding/sodding as indicated in Part 3.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Source: Provide from off site, Architect approved source, when stripped and stockpiled quantity is inadequate to provide four (4") or six (6") inches settled depth of topsoil for lawn areas at no additional cost to the Owner.
- B. Texture and Content: Provide topsoil conforming to the following:
 1. Soil texture and content:
 - a. Sandy loam topsoil, well drained homogeneous texture and of uniform grade, without the admixture of subsoil material. Topsoil shall be entirely free of dense material, hardpan, clay, stones over 3/4" in diameter, sod, or any other objectionable foreign material, including but not limited to, glass, debris, toxins, hazardous wastes and chemicals (such as atrizene or muriatic acid) that may be injurious to humans, animals and plant materials.
 - b. Organic Matter: Containing not less than 5% or more than 10% organic matter in that portion of a sample passing a 1/4" sieve when determined by the wet combustion method on a sample dried at 105 degrees C.
 2. pH Value: Containing a pH value within the range of 6.5 to 7.5 on that portion of the sample which passes a 1/4" sieve.
 3. Soluble salt content: Not higher than 500 parts per million.
 4. Sieve Analysis for general lawn work: Shall be screened or rock picked to meet the following gradation:

<u>Sieve Designation</u>	<u>% Passing</u>
3/4"	100
1/4"	97-100
No. 200	20-50 (of the 1/4" sieve)

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5. Sieve Analysis for Athletic Field lawn work: Shall be mechanically screened by an onsite screening facility provided by the Contractor prior to placing and spreading. It shall meet the above requirements.

2.2 WETLAND SEED MIX (LAWN TYPE 3)

A. To be used along the entire basin sides and bottom as shown on plans.

B. OBL - Wetland Mix:

33.0% *Carex vulpinoidea*, PA Ecotype (Fox Sedge, PA Ecotype)

10.0% *Sparganium eurycarpum*, PA Ecotype (Giant Bur Reed, PA Ecotype)

8.0% *Carex lupulina*, PA Ecotype (Hop Sedge, PA Ecotype)

8.0% *Carex lurida*, PA Ecotype (Lurid Sedge, PA Ecotype)

8.0% *Carex scoparia*, PA Ecotype (Blunt Broom Sedge, PA Ecotype)

7.0% *Sparganium americanum* (Eastern Bur Reed)

5.0% *Elymus virginicus*, PA Ecotype (Virginia Wildrye, PA Ecotype)

4.0% *Verbena hastata*, PA Ecotype (Blue Vervain, PA Ecotype)

3.0% *Juncus effusus* (Soft Rush)

2.5% *Asclepias incarnata*, PA Ecotype (Swamp Milkweed, PA Ecotype)

1.0% *Aster puniceus*, PA Ecotype (Purplestem Aster, PA Ecotype)

1.0% *Aster umbellatus*, PA Ecotype (Flat Topped White Aster, PA Ecotype)

1.0% *Cinna arundinacea*, PA Ecotype (Wood Reedgrass, PA Ecotype)

1.0% *Eupatorium perfoliatum*, PA Ecotype (Boneset, PA Ecotype)

1.0% *Helenium autumnale*, PA Ecotype (Common Sneezeweed, PA Ecotype)

1.0% *Scirpus atrovirens*, PA Ecotype (Green Bulrush, PA Ecotype)

0.5% *Alisma subcordatum*, PA Ecotype (Mud Plantain, PA Ecotype)

0.5% *Carex crinita*, PA Ecotype (Nodding Sedge, PA Ecotype)

0.5% *Carex stricta*, PA Ecotype (Tussock Sedge, PA Ecotype)

0.5% *Iris versicolor*, PA Ecotype (Blueflag, PA Ecotype)

0.5% *Lobelia siphilitica*, PA Ecotype (Great Blue Lobelia, PA Ecotype)

0.5% *Ludwigia alternifolia*, PA Ecotype (Seedbox, PA Ecotype)

0.5% *Onoclea sensibilis* (Sensitive Fern)

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- 0.5% Penthorum sedoides, PA Ecotype (Ditch Stonecrop, PA Ecotype)
- 0.5% Scirpus cyperinus, PA Ecotype (Woolgrass, PA Ecotype)
- 0.5% Scirpus validus, PA Ecotype (Softstem Bulrush, PA Ecotype)
- 0.3% Eupatorium fistulosum, PA Ecotype (Joe Pye Weed, PA Ecotype)
- 0.1% Chelone glabra, PA Ecotype (Turtlehead, PA Ecotype)
- 0.1% Mimulus ringens, PA Ecotype (Square Stemmed Monkeyflower, PA Ecotype)

C. Acceptable seed supplier shall be:

ERNST Seeds
(800)-873-3321

Or Architect approved equal.

2.4 SOD (LAWN TYPE 1 and 2)

- A. Sod shall conform to NYSDOT Item 713-14. Approved nursery grown pasture sod with majority 60% Kentucky Bluegrass and minority 40% Fine Fescue blend. Use of plastic netting is NOT acceptable.
- B. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, and free of weeds, undesirable grasses, stones, roots, thatch and extraneous material viable and capable of growth and development when planted. Sod is considered free of weeds when less than five (5) weeds are found per one hundred (100 s.f.) square feet.
- C. Furnish sod machine stripped and of supplier's standard width, length, and thickness: uniformly 1" to 1-1/2" thick with clean cut edges. Mow sod before stripping.
- D. Mowing Height: Before stripping, sod shall be mowed uniformly at a height of 1 to 1-1/2 inches.
- E. Thickness of Cut: Sod shall be machine cut at a uniform soil thickness of 5/8 inch, plus or minus 1/4 inch, at the time of cutting. Measurement for thickness shall exclude top growth and thatch.
- F. Thatch: Sod shall be relatively free of thatch, up to 1-2 inch allowable (un-compressed).
- G. Pad Size: Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus 1/2" on width and plus or minus 5% on length. Broken pads and torn or uneven ends will not be acceptable.
- H. Strength of Sod Sections: Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10% of the section.

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2.5 LIMESTONE

- A. Shall be ground limestone in the producer's standard bags containing not less than 85% total carbonates and conforming to the following gradations:

<u>Sieve Designation</u>	<u>% Passing</u>
No. 100	50-100
No. 20	100

2.6 TACKIFIER FOR SEEDED LAWNS

Shall be liquid concentrate diluted with drinkable water forming a transparent three-dimensional film-like crust permeable to water and air, containing no agents toxic to seed germination to hold straw mulch in place. Standard of quality shall be Terra Tack as supplied by Northern Nurseries, 315-699-3999, or Architect approved equal.

2.7 FERTILIZER

- A. For Starter Fertilization: Immediately prior to seeding, fertilize with a commercial starter fertilizer, granular, non-burning product, with not less than 50% organic, slow acting, micro nutrients and 1% iron, guaranteed analysis commercial fertilizer. Fertilizer rate shall be: 8-16-8. Apply at a rate of 1 lb. of phosphorous per 1,000 s.f.
- B. For Subsequent and Final Fertilizations: Apply commercial fertilizer, poly coated, granular non-burning product with not less than 50% organic slow acting, guaranteed analysis
1. For Spring Lawn Work: Fertilizer ratio shall be: 1-2-1. Apply at rate of 1.5 lbs of Nitrogen per 1,000 s.f. as recommended by the topsoil testing agency for maximum growth. Refer to 329201, 1.3, C, 2.
 2. For Fall Lawn Work: Fertilizer ration shall be: 1-2-1. Apply at rate of 1 lb. of actual phosphorous per 1,000 s.f. or as recommended by the topsoil testing agency for maximum growth. Refer to 329201, 1.3, C, 2.

2.8 MULCH FOR SEEDED LAWNS

- A. When not hydroseeding, shall be straw consisting of clean stalks of oats, wheat, rye or other approved crops well seasoned before baling which are free of noxious weed seeds and roots.
- B. When hydroseeding, shall be hydromulch containing 100% paper fiber mulch. Standard of quality shall be Natural Fiber Hydromulch or Penn Mulch as distributed by Northern Nurseries, (315) 699-3999 or Architect approved equal.

2.9 WATER: Free of substance harmful to lawn, other plants, humans and animals.

2.10 COMPOST

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A. Compost shall contain organic matter or material of a generally humus nature capable of sustaining vegetation growth, with no foreign matter (ie. glass, plastic, etc.) or other material toxic to plant growth. It shall be free from stones, lumps, or similar objects larger than one-half inch in greatest diameter, roots, and brush. Composts derived from organic wastes such as food and agricultural residues and animals manures, and sewage sludge that meet the above requirements, and are approved by the National Environmental Protection Agency and NYS Department of Environmental Conservation are acceptable compost sources.

B. Compost shall have the following properties:

<u>Parameters</u>	<u>Range</u>
pH	6.0 to 7.5
Moisture Content	35 to 55%
Particle Size	< 1/2"
C:N Ratio	15:1 to 30:1

<u>Field Specific Requirements</u>	<u>Min. Compost Needed</u>
Baseball field 3	125 cy

D. Standard of quality shall be Agresoil Compost as distributed by Agresource, (800) 313-3320, or Architect approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify limits of lawn and other types of ground cover materials in the field with drawings. Also any imported and screened topsoil areas. Notify Architect of discrepancies prior to proceeding with lawn work.
- B. Examine finish surfaces, grade, topsoil quality, and depth.
- C. Do not start lawn work until unsatisfactory conditions are corrected to the approval of the Architect.

3.2 SPREAD TOPSOIL

- A. Limit preparation to areas which will be immediately seeded or sodded.
- B. Perform topsoil spreading operations only during dry weather.
- C. To insure a proper bond with the topsoil, disc, harrow, or otherwise scarify and loosen the lawn subgrade to a depth of six (6") inches before spreading topsoil.
- D. Spread topsoil to ensure a minimum settled depth of four (4") or six (6") inches in lawn areas.

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3.3 PREPARE LAWN AREAS TYPES 1 AND 3

- A. Perform a pH test, sieve, and nutrient analysis of the topsoil and advise the results to the Architect prior to adding limestone or other soil amendments.
- B. Remove debris. Remove stone 3/4" or larger by handpicking, fine tooth aluminum grading rakes, and/or mechanized stone picker. When topsoil has hardened, cultivate soil to a four (4") or six (6") inch depth by plowing, discing, harrowing, or otherwise scarifying and loosening the topsoil.
- C. Grade lawn areas to a smooth, free draining even surface with a loose, moderately coarse texture. Roll, scarify, rake, and level as necessary to obtain true, even lawn surfaces and fill depressions as required to drain. Correct irregularities in the surface resulting from tillage operations to prevent formation of depressions or water pockets.
- D. Cultivate soil to provide a firm bed of minimum of four (4") inches deep, free of clods, stones, or foreign matter over one (1") inches in diameter from the top of soil. Do not move heavy objects except necessary lawn making equipment (equipped with specialized turf tires so that psi on the turf will be less than 12 psi when loaded to full capacity) over the lawn areas after the soil is prepared unless it is again loosened and graded to the approval of the Architect. Remove stones greater than 3/4" in diameter during cultivation. Level undulations and irregularities in the surface.
- E. Provide adjusted rate of application as recommended in Topsoil Test Report submittal (Section 329201, 1.3, C.2) when rate differs from the following: Add ground limestone at the rate of 100 lbs. per 1,000 S.F. or equivalent acidifier as directed by the Architect.
- F. Place starter fertilizer at the rate of 1 lb. of phosphorous per 1,000 S.F. and mix into full depth of topsoil.
- G. Rake area with fine toothed aluminum grading rake before placing seed to obtain a smooth surface at the proper elevation. Drag area with a wood float to level out minor humps and hollows. Beds shall have a smooth friable uniform surface, free of areas ponding water.

3.4 MODIFY, SCREEN AND SPREAD TOPSOIL IN ATHLETIC LAWN AREAS TYPE 2

- A. Screen modified topsoil to remove objects greater than 3/4" prior to spreading.
- B. Premix by volume the compost required under 2.10 to six (6") inches stockpiled or imported topsoil (total 6" settled depth). Perform a pH test of the premixed material and advise the results to the Architect prior to placing limestone or other soil amendments.
- C. Perform modified topsoil spreading only during dry weather. Spread to ensure a minimum settled depth of six (6") inches.
- D. Grade lawn areas to smooth, free draining even surface with a loose, moderately coarse texture. Roll, scarify, rake, and level as necessary to obtain true, even lawn surfaces and

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- fill depressions as required to drain. Correct irregularities in the surface resulting from tillage operations to prevent formation of depressions or water pockets.
- E. Add ground limestone at the rate of 100 lbs. per 1,000 s.f. or equivalent acidifier as directed by the Architect when required by pH testing results.
 - F. Place starter fertilizer at the rate of 1 lb. of phosphorous per 1,000 S.F. and mix into full depth of topsoil.
 - G. Rake area with fine toothed aluminum grading rake before placing seed or sod on athletic fields to obtain a smooth surface at the proper elevation. Drag area with a wood float to level out minor humps and hollows. Beds shall have a smooth friable uniform surface, free of areas ponding water.
 - H. Prior to sodding, place temporary striping lines on the athletic fields with a marking mixture which is not toxic to seed germination. Place straight lines across fields 15' on center. These lines will be reviewed to determine visual planarity of the topsoil surface. Correct high and low spots as directed by the Architect. Drag and spread lines prior to seeding or sodding.

3.5 LAWN SEEDING

- A. Notify Architect when seed bed is ready for review as specified in Job Conditions. Obtain Architect's approval of finish grade **prior** to seeding operations.
- B. Seed lawns immediately after preparation of bed and Architect's approval.
- C. For General Lawn Type 1 and 2, seed at the rate of 6 lbs. per 1,000 S.F.

3.6 MULCHING SEEDED AREAS

- A. Mulch immediately after seeding.
- B. Place mulch by hand or by machine at a rate of one bale/1,000 sq. ft. to produce a light even mulch cover so that 50% of soil is visible through the mulch layer.
- C. Anchor mulch by thorough heavy coat of tackifier over entire area and watering.
- D. Protect seed bed from washout, wind erosion, rutting and drying out. Do not use machinery that leaves ruts in the seed bed. It is the Contractor's responsibility to add or remove mulch as needed to encourage optimum seed germination and growth.

3.7 SODDING (LAWN 1 AND 2)

- A. Notify Architect that sod bed is ready for review as specified in Job Conditions. Obtain Architect's approval prior to sodding.
- B. Moistening the Soil: During periods of higher than optimal temperature for species being specified and after unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to laying the sod.

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- C. Sod immediately after preparation of bed and Architect's approval.
- D. Lay sod to form a solid mass with tightly-fitted joints in strips parallel to contours. Butt ends and sides of sod strips. Do not overlap edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with finish grade of adjacent curbs, pavements, drainage structures and seeded areas.
- E. Do not lay dormant sod or install sod on soil surfaces that are hot, dry, saturated or frozen.
- F. When sodding slopes, install initial row of sod in a straight line, beginning at bottom of slope. Place subsequent rows parallel to and lightly against previously installed row.
- G. Sod strips laid in drainageways must meet the finished grades shown on the drawings.
- H. Stake sod in lawn swales and on lawn slopes 3H to 1V (horizontal to vertical) and steeper to prevent slippage. Use two (2) biodegradable stakes per square yard of sod. Stakes are to have their flat sides against the slope and be driven flush with sod surface.
- I. Roll with light lawn roller to ensure contact with subgrade.
- J. Water sod thoroughly with a fine spray immediately after laying. Do not allow sod to dry out.

3.8 MAINTENANCE

- A. Maintenance by Contractor begins as soon as lawns are sodded or seeded. Protect lawns from drought, washout and wind erosion. In general, maintain new installed lawn areas, including watering, fertilizing, core aerating, spot weeding, mowing, applications of herbicides, fungicides, insecticides, and re-sodding until a full, uniform, healthy, vigorous stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Architect. Specifically:
 - 1. Watering Seeded Lawns: Provide water, backflow preventors, meters, labor, hoses, sprinklers and watering equipment needed to promptly germinate the lawn seed, preventing it from drying out, and keeping it in a healthy, growing condition until final acceptance. The Owner will pay for water usage including trucking if required. Lawn areas shall receive a minimum of one (1") of water per week, by natural rainfall, irrigation or a combination of both.
 - 2. Watering Sodded Lawns:
 - a. First Week: Provide water, meters, labor, hoses, sprinklers and watering equipment for rooting of the sod. The Owner will pay for water usage including trucking if required. Soil on sod pads shall be kept moist. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least four (4") inches. Lawn areas

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shall receive a minimum of one (1") of water per week, by natural rainfall, irrigation or a combination of both.

3. Second and Subsequent Weeks: Provide water, back flow preventors, meters, labor, hoses, sprinklers and watering equipment as required to maintain adequate moisture, in the upper four (4") inches of soil, necessary for the promotion of deep root growth until final acceptance. The Owner will pay for water usage including trucking if necessary. Lawn areas shall receive a minimum of one (1") of water per week, by natural rainfall, irrigation or a combination of both.
4. Protect: Protect lawn areas against trespass, vandalism and routine pedestrian traffic and Owner maintenance by temporary fencing or other means.
5. Repair: Repair, rework, and resod or overseed areas that have washed out, eroded, do not germinate and are vandalized or otherwise damaged. Overseeding rates are to be adjusted to 8 lbs. of seed per 1,000 s.f.
6. Mow: Initial mowing shall begin when the blade height reaches 2" and the soil will bear the weight of the lawn mower. Use mowers with low impact tires. For the first 3 mowings cut the grass blades to 1.5 inches. After that mow the grass when it reaches a height of about 3.5" to a height of about 2.5". Never remove more than 1/3 of the grass blade at any one mowing. A minimum of ten (10) mowings are required (approximately once per week after the initial germination period to final acceptance). Notify the Architect of dates in writing as mowing is performed. Excess clippings shall be carefully raked so as not to remove healthy grasses, and removed.
7. Core Aerating: Between mowings three (3) and four (4), and between mowings seven (7) and eight (8) core aerate lawns about three (3") inches on center minimum three (3") inches deep to ensure aggressive root growth. This will require multiple passes at different directions to achieve 16 to 20 holes 3/4" to 1" diameter per square foot. Sweep scattered plugs off paved areas onto adjacent lawn areas. Pulverize plugs during subsequent mowing operations. Provide additional core aerating after the 10th mowing as directed by the Architect to expedite the lawn maturation process. Moisten field by thoroughly watering the topsoil profile, several days in advance of coring to facilitate proper penetration of the topsoil.
8. Fertilizer: Immediately after core aerating, between mowings three (3) and four(4), and between mowing seven (7) and eight (8) apply subsequent fertilizer at the rate of 10 lb./1,000 s.f. Provide additional fertilizer after the 10th mowing as directed by the Architect to expedite the lawn maturation process. Apply a final fertilizer just prior to final acceptance at the same application rate.
9. Weed Control: When infestation of weeds or crabgrass develops, treat infestation by hand weeding or herbicides control appropriate to the area. Furnish and install weed chemical control as recommended by manufacturer. Herbicides controls must be acceptable to the Owner. Obtain and pay for permits. Use as directed by the manufacturer and applicable laws, codes,

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ordinances and regulatory requirements. Under NO circumstances is it acceptable to seed or overseed over Nutsedge, Crabgrass or other grassy/broadleaf weeds.

- B. Maintenance by the Contractor continues through the certificate of substantial completion to final acceptance by the Architect as described below. Maintenance by Owner begins after final acceptance of the lawn.

3.10 STANDARDS FOR SUBSTANTIAL COMPLETION OF LAWNS: Review to determine substantial completion of lawns will be made by the Architect, upon request. Provide notification at least five (5) working days before requested review date.

- A. Lawn areas will be substantially complete provided requirements, including maintenance, have been complied with. A healthy, vigorous, uniform, partially mature stand of lawn is established free of weeds, undesirable grass species, disease, and insects. This will culminate after an approximate 60 day period with average temperatures above 40°F of maintenance including watering, protection, repair, mowing, core aerating, weed control, and fertilizing as noted above. Grass roots shall have matured to a minimum of 1½" depth as determined by the Architect when core samples are taken.
- B. Lawn areas shall not have more than 10% dead/bare spots.
- C. The architect will prepare a written punch list of items which need correction prior to final acceptance.

3.11 STANDARDS FOR FINAL ACCEPTANCE OF LAWNS: Review to determine final acceptance of lawns will be made by the Architect, upon request. Provide notification at least five (5) working days before requested review date.

- A. Lawn areas will be acceptable provided requirements, including maintenance, have been complied with. A healthy, vigorous, uniform, full stand of lawn is established free of weeds, undesirable grass species, disease, and insects. Grass roots shall have matured to a minimum of 2" depth as determined by the Architect when core samples are taken.
- B. Any lawn which contains disease, more than 2% dead/bare spots, or any dead/bare area greater than one square foot shall be rejected and the unacceptable area(s) repaired as originally specified at no additional cost to the Owner.
- C. In the event the Contractor fails to complete the punch list items within a 30 day period with average temperatures of 40°F after the time of Substantial Completion, the Contractor shall be liable to the Owner for any additional costs including those charged by the Architect.

3.12 CLEAN UP

During the contract and at intervals as directed by the Architect and as lawn work is completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, neat, well-draining condition.

END OF SECTION 329201

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SECTION 334001 - STORM DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the storm drainage is shown on the drawings.
- B. Storm drainage work includes, but is not limited to:
 - 1. Trenching, backfilling and compaction
 - 2. Storm structures and appurtenances
 - 3. Piping, jointing and fittings (to five feet from exterior building face)
 - 4. Connection(s) to other storm system(s)
 - 5. Adjusting existing storm structures and other utilities
 - 6. Flared end section(s)
 - 7. Storm Water Management Trench(s)
 - 8. Flat Drains
 - 9. Vertical Drains
 - 10. Quality Control Testing and Submittals
 - 11. Clean Up
- C. Provide materials, labor, equipment and services required to accomplish related work in accordance with the drawings and specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 311201 - Site Preparation
- B. Section 312501 - Erosion, Sediment and Pollution Control
- C. Section 312201 - Site Earthwork: For Elaboration of Shoring and Bracing, Dewatering, Backfilling, Compaction and Field Quality Control Testing.
- D. Section 321201 - Asphalt Paving
- E. Section 321301 - Site Concrete

1.3 REFERENCES

- A. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.

1.4 SUBMITTALS: (See Section 311201, 1.5)

- A. Shop Drawings (SD) required for:
 - 1. Precast concrete drainage structures showing sizes, elevations for openings and, HS20 loading certification.
 - 2. Area Drain Structures

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- B. Manufacturer's Product Data (MPD) required for:
 - 1. Drainage structures and castings
 - 2. Pipe, joints and fittings
 - 3. Vertical Drains
 - 4. Flat Drains
 - 5. Stormwater Management Trench for Pipes and Geotextiles
 - 6. Flared End Section(s)

- C. Quality Control Submittals:
 - 1. Provide a list of completed projects including Owner's contact information for each project, demonstrating compliance with applicable "Experience Requirements" specified in "Quality Assurance" of this specification section.

1.5 QUALITY ASSURANCE

- A. Drainage Contractor Experience Requirements:
 - 1. Submit business name, business owner(s) name(s), business address, telephone number, website and/or email address signed by the Contractor/Subcontractor who meets the qualifications set forth in this specification and is proposed by the Contractor to perform the Drainage for this Project.
 - 2. Provide a list of at least four (4) Drainage work projects of comparable size, scope and quality completed successfully by the proposed Contractor/Subcontractor within the past two (2) years that includes the date completed, project Owner's name and current contact information, including telephone numbers and email addresses.

1.6 JOB CONDITIONS

- A. Job conditions in Section 312201 apply.
- B. Plan and execute piping work so that trenches are not opened for more than two hundred (200') feet in advance or left unfilled more than one hundred (100') feet behind. No overnight open excavation is permitted.
- C. CERTIFICATION OF STORM SYSTEM: The storm system must be installed and certified by a licensed County Plumber when required by municipal code or state law.
- D. CONSTRUCTION REVIEW: Notify the Architect when the storm system is approximately 25%, 75% and 95% complete.

1.7 SUBSTITUTIONS

- A. Contractor is responsible for design of any substituted structures, systems or units in Section 334001 by a NYS licensed engineer. Submit to Architect for approval.

PART 2 - PRODUCTS

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2.1 BACKFILL

- A. Backfill for pipes, Stormwater Management Trenches (SMT), drainage structures, and drywells shall be as specified in Section 312201.

2.2 STORM STRUCTURES AND CASTINGS

A. Storm Inlets, Manholes and Catch Basins:

1. Shall be 5,000 psi pre-cast concrete with reinforcement conforming to ASTM C478 and ASTM A615 with AASHTO HS20 Loading. Openings shall be pre-cast in each unit at the factory. Ring joints shall be O-ring rubber gasket type and sealed in accordance with ASTM C990. Base units shall be extended. Size(s) as shown on drawings and constructed of reinforced Portland Cement concrete; as manufactured by Zeiser Wilbert, Jefferson Concrete, Fort Miller or Architect approved equal.
2. Castings: Provide HS20 loading and bike safe grates, ductile iron meeting grade 65-45-12 as determined by ASTM A536-84, sizes as noted on the plans. Frames, covers and grates shall be machined to prohibit rocking. Standard of Quality shall be Neenah Foundry, East Jordan Iron Works, US Foundry, or Architect approved equal. Refer to drainage details on drawings for model numbers and other information on castings.

B. Dry Wells:

1. Shall be pre-cast concrete with reinforcement conforming to ASTM C478-11 and ASTM A615 with AASHTO HS20 Loading. Openings shall be precast in each unit at the factory. Size(s) as shown on drawings and constructed of reinforced Portland Cement concrete; as manufactured by Zeiser Wilbert, Jefferson Concrete, Fort Miller or Architect approved equal.
2. When the size of a manufacturer's product differs from the item as detailed on the drawings, provide the manufacturer's next larger size than detailed unless approved by the Architect in writing.
3. Castings: Provide HS20 loading and bike safe grates, ductile iron meeting grade 65-45-12 as determined by ASTM A536-84, sizes as noted on the plans. Frames, covers and grates shall be machined to prohibit rocking. Standard of Quality shall be Neenah Foundry, East Jordan Iron Works, US Foundry, or Architect approved equal. Refer to drainage details on drawings for model numbers and other information on castings.

C. Area Drain(s): Shall be a watertight PVC, HS-20 loaded drain basin with drop-in integral grates. Structures shall be able to accommodate all connecting pipes watertight. Refer to drawings for sizes and grate styles.

1. 10" Standard light-duty drop-in grate.
2. Standard of quality shall be Nyloplast as distributed by Advanced Drainage Systems, Inc., 800-821 6710, or Architect approved equal.

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2.3 STORM STRUCTURE APPURTENANCES

- A. Precast Concrete Adjustment Rings: Shall be square or round depending on structure. Built in accordance to ASTM C478, and made of 5,000 psi concrete and reinforced steel, meeting ASTM A615 Grade 60, as manufactured by Fort Miller, Zeiser Wilbert, Jefferson Concrete or Architect approved equal.
- B. Steps: Shall be copolymer polypropylene plastic reinforced with 1/2" diameter grade 60 steel as manufactured by M.A. Industries or Architect approved equal.
- C. Mortar: Shall be lime, cement, and clean sand, 1:1:3 measured by volume.

2.4 PIPING

- A. High Density Polyethylene Pipe (HDPE):
 - 1. 4" to 10" Pipe: Shall be dual wall, heavy duty polyethylene (HDPE) pipe with a smooth inner wall, annular corrugations, "n" flow rating of 0.012, and HS-20 loading capability with minimum one (1') foot cover. Pipe shall meet the requirements for Type S pipe under AASHTO M252. Joint couplings for pipe shall be connected using a bell & spigot joint, meeting AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be soil tight and gaskets, when applicable, shall meet the requirements of ASTM F477. Standard of quality shall be N-12 ST IB pipe as manufactured by Advanced Drainage Systems, Inc., 800-821 6710, or Architect approved equal.
 - 2. 12" to 36" Pipe: Shall be dual wall, heavy duty polyethylene (HDPE) pipe with a smooth inner wall, annular corrugations, "n" flow rating of 0.012, HS-20 loading capability with minimum one (1') foot cover and a minimum recycled content of 40%. Pipe shall meet ASTM F2648. Joint couplings for all pipe shall be connected using a bell & spigot joint, meeting ASTM F2306. The joint shall be soil tight and gaskets, when applicable, shall meet the requirements of ASTM F477. Standard of quality shall be Mega Green ST IB pipe as manufactured by Advanced Drainage Systems, Inc., 800-821 6710, or Architect approved equal.

2.5 FLARED END SECTIONS

- A. Flared end sections for HDPE pipe shall be high density polyethylene.

2.6 STORM WATER MANAGEMENT TRENCH

- A. 4" to 10" Pipe and Fittings: Shall be flexible, heavy duty, corrugated interior and exterior, perforated (or slotted) polyethylene pipe meeting requirements ASTM F-405 for 4" to 6" diameters and ASTM F667 for 8" to 10" diameters. Standard of quality shall be ADS with prefabricated snap fittings as manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.
- B. 12" to 24" Pipe and Fittings: Shall be heavy duty polyethylene (HDPE), corrugated interior and exterior, perforated pipe meeting requirements AASHTO M252, AASHTO M294, Type C. Standard of quality shall be ADS with prefabricated fittings as

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manufactured by Advanced Drainage Systems, Inc., (614) 457-3051 or Architect approved equal. Size pipe(s) as noted on drawings.

- C. Backfill: Shall be clean, washed No. 1 stone as indicated in Section 312201.
- D. Soil Separation Fabric: Shall be a commercially manufactured non-woven polypropylene filter fabric. Standard of quality shall be Mirafi 140N as manufactured by TenCate or Architect approved equal.

2.7 VERTICAL DRAIN

- A. Standard of quality: shall be filter-wrapped, flat underdrain J-Drain SWD-6 as manufactured by JDR Enterprises Inc. (800) 843-7569 or Architect approved equal.
- B. Provide the 6-4 Endout to connect the J-Drain to a 4" perforated pipe and solid wye coupler to the storm water management trench piping. Secure with PVC tape.
- C. Backfill: Shall be clean, coarse concrete sand, graded as indicated in Section 312201.

2.8 FLAT DRAINS

- A. Shall be perforated filter-wrapped, oblong, 13" wide x 1.5" thick with internal bracing meeting ASTM D7001. All fittings shall be made of polyethylene with a min. cell classification of 424420C as defined and described in ASTM D 3350.
- B. Standard of quality shall be ADS Advanedge as manufactured by Advanced Drainage Systems, Inc., (Tel. 800-821-6710) or Architect approved equal.
- C. Provide the 12-4 Endout to connect the Flat Drain to a 4" perforated pipe that wye couples to the storm water management trench piping.
- D. Secure all connections using manufacturer recommended PVC tape at all joints.

PART 3 - EXECUTION

3.1 CONNECTIONS TO OTHER STORM SYSTEM

- A. Connections at Building(s):
 - 1. Locate accurately per site and plumbing drawings. Verify invert and sizes. Notify Architect of any discrepancies immediately, prior to installation.
 - 2. Install pipe and jointing to within five (5') feet of each building exterior. Install temporary plugs, cap end, mark above grade, and protect. Coordinate with Plumbing Contractor. Connection will be made by Plumbing Contractor.
 - 3. The Plumbing Contractor shall be responsible for connecting the building drains and leaders to the site storm system.
 - 4. Make connections securely, watertight and as detailed. Provide all necessary couplers and fittings to make connections.

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- B. Connections to existing Storm Systems:
 - 1. Coordinate with the Municipality and other agencies having jurisdiction. Notify governing agency in writing a minimum of two (2) weeks prior to anticipated date of connection so that field procedures and installation can be reviewed by a representative of the Municipality. Copy letter to Architect.
 - 2. Locate accurately per drawings. Verify inverts and sizes. Notify Architect of any discrepancies immediately, prior to installation.
 - 3. Make connections securely, watertight and as detailed. Provide all necessary couplers and fittings to make connections.

3.2 TRENCHING AND BACKFILL

- A. Reference: Refer to Section 312201 for elaboration of shoring and bracing, supporting, rock, dewatering, and backfilling.
- B. Trenching:
 - 1. Remove material encountered to the depth shown on drawings and with a maximum width of fourteen (14") inches and a minimum of nine (9") inches each side of conduit springline as detailed. Provide safe shoring, sheeting, and bracing. Remove before backfilling. Backfill excess or over excavation as described in Section 312201 to proper line and grade. Compact to 95% density.
 - 2. When unsatisfactory soil materials are encountered at design elevations, immediately notify the Architect in writing via email. Continue as directed by the Architect. When conditions are not a result of Contractor's negligence, additional excavation may be directed by the Architect and paid for as a Change Order on a unit price basis in accordance with specification Section 312201.
- C. Water: Remove from trenches; drain trenches and/or provide sump pits and pumping equipment as necessary to keep trenches stable and dry at no additional cost to the Owner.
- D. Soft Material in Trench Bottom: Dry out and stabilize or remove and replace with imported granular backfill material to achieve firm, stable foundation at no additional cost to the Owner.
- E. Rock: Remove boulders and rock within one (1'-0") foot of pipe. Provide one (1'-0") foot of granular backfill between rock and conduits at no additional cost to the Owner.
- F. Backfill: Conform to details on drawings and as specified. Compact backfill to a minimum 95% of optimum density.

3.3 STORM STRUCTURES INSTALLATION

- A. Pre-Cast Structures:

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1. Install with corresponding extended precast base section. Precast base units shall be modified in the factory to have the correct size openings for piping.
 2. Provide drainage structures as detailed, built to finished grades given. Backfill with imported granular backfill material around drainage structure and compact to 95% density to avoid settlement.
 3. Mortaring: Thoroughly wet concrete risers before laying. Mortar joints. Joints shall be completely full and struck flush.
 4. Install any required steps in a continuous flight, avoiding any conflict with piping.
 5. Construct channels in base of storm structures for positive flow from inlet to outlet piping where detailed.
 6. Build completed structure to avoid any infiltration or exfiltration of water except at underdrains or storm water management trenches.
- B. Dry Well Units: Install as detailed, built to finished grades given. See masonry details for installation of casting. Build drywells to facilitate exfiltration of water. Line drywells with soil separation fabric and backfill with No. 1 stone as specified.

3.4 CASTINGS

- A. Provide the type specified and shown on drawings. Build to the finish grade as shown on drawings.
- B. Set castings firmly. Loose or rocking castings shall be rejected by the Architect.
- C. Paint all installed castings (inside and outside) with two (2) coats of black rust inhibitive paint as directed by the Architect.

3.5 ADJUSTING EXISTING UTILITIES

Adjust existing utilities as necessary to maintain utility service and meet finished grade conditions. Existing utilities include but are not limited to; hydrants, water valves, gas valves, electric pull boxes and manholes, storm drainage structures, cable and telephone markers, fiber optic cables, sanitary cleanouts and manholes, and guy wires.

3.6 PIPE LAYING

- A. Shall be in accordance with ASTM D2321 and pipe manufacturer requirements.
- B. Bed pipe in granular backfill or concrete as shown on drawings, compact under springline of pipe to assure firm support. Align pipe to line and grade given in plan and profile. Set batter boards or set by laser level.
- C. Pipe joints shall be made using the flexible gaskets specified. Clean bell end of any debris and lubricate. Remove protective wrap from gasket. Do not allow lubricated section to touch dirt or backfill. Foreign matter could adhere to surface and compromise

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joint integrity. Push together pipes so that the gasket is firmly seated in the socket. Always push spigot end into bell, not bell end into spigot.

- D. Place backfill around pipes to equal depths on both sides as work progresses.
- E. Attach flared end sections as detailed to pipe outlets, draw up bolts tight to provide firm anchorage.
- F. "Lamp" pipes to check for misalignment and breakage after backfilling has been completed. Replace pipes deviating more than 1/2" from line or grade at no additional cost to the Owner.

3.7 CONCRETE CRADLES, SADDLES AND COLLARS

As specified in Section 321301.

3.8 STORM WATER MANAGEMENT TRENCH

- A. Use only pipe which is undamaged and flexible (have not been exposed to direct sunlight for more than six (6) months causing brittleness, cracking or splitting prior to placement). Pipe shall be stored for at least twenty-four (24 hrs.) hours in an area having a minimum temperature of fifty (50) degrees F.
- B. Trenching: Remove material encountered to the depth shown on the drawings. Provide shoring, sheeting, and bracing as necessary for safety; remove before backfilling.
- C. Install continuous envelope of soil separation fabric around the backfill up to subgrade of finish material. Fill stone to proper elevation and wrap top. Overlap fabric minimum twenty-four (24") inches at top and joints. Secure fabric joints to prevent separation and infiltration of adjacent materials and separation of fabric.
- D. Install pipe sloped as shown on drawings.
- E. Compact backfill to maximum density of adjacent materials.

3.9 VERTICAL DRAINS

- A. Install the Vertical Drains at the intervals noted on the drawings. Securely attach ends of these composite drains into the perimeter collector header system. Provide all fittings for secure connections.

3.10 FLAT DRAINS

- A. Install the Flat Drains at the intervals noted on the drawings. Securely attach ends of these composite drains into the perimeter collector header system with specified fittings.
- B. Secure all connections with PVC tape.

3.11 FIELD QUALITY CONTROL

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- A. Density Testing: Perform all density testing for piping trenches and structure backfill as indicated in Section 312201.

3.12 CLEAN UP

- A. During the contract and at intervals as directed by the Architect and as storm drainage is completed, clear the site of pipe, trench and backfill material, stone, concrete and debris. Leave the site in a clean, safe, well draining, neat condition.
- B. Clean drainage structures, storm water management trenches and pipes: Clean out sediment, rubbish, construction debris, and foreign objects thoroughly, immediately prior to final acceptance.

END OF SECTION 334001

