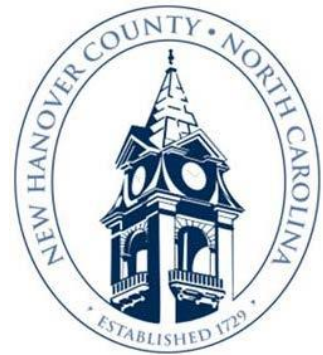


# THE HEALING PLACE of New Hanover County



*Wilmington, NC*

Construction Documents

**August 25, 2020**

VOLUME TWO

(Divisions 21-33)



219 North Boylan Avenue Suite 100  
Raleigh, North Carolina 27603

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Specification Sections or Divisions provided by the following firms as indicated in the Table of Contents:

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- Structural Specifications: -----RED Engineering & Design – “**red**”
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- Fire Suppression Specifications: ----- Crawford Sprinkler – “**cs**”
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SECTION 210000 - WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
  - 2. Fire-protection valves.
  - 3. Fire-department connections.
  - 4. Sprinklers.
  - 5. Alarm devices.
  - 6. Pressure gages.

1.3 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.
  - 1. Available fire-hydrant flow test records indicate the following conditions:

Construction Documents

- a. Date: 6/24/2020
  - b. Time: -
  - c. Performed by: Troy Davidson
  - d. Location of Residual Fire Hydrant: -
  - e. Location of Flow Fire Hydrant F: -
  - f. Static Pressure at Residual Fire Hydrant R: 65 psi
  - g. Measured Flow at Flow Fire Hydrant F: 1165 pgm
  - h. Residual Pressure at Residual Fire Hydrant R: 60 psi
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: 10 psi, including losses through water-service piping, valves, and backflow preventers.
  2. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1
    - c. General Storage Areas: Ordinary Hazard, Group 1
    - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1
    - e. Office and Public Areas: Light Hazard
    - f. Restaurant Service Areas: Ordinary Hazard, Group 1
  3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft..
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft.
  4. Maximum Protection Area per Sprinkler: Per UL listing.
  5. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 225 sq. ft.
    - b. Storage Areas: 130 sq. ft.
    - c. Mechanical Equipment Rooms: 130 sq. ft.
    - d. Electrical Equipment Rooms: 130 sq. ft.
    - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
  6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes requirement.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.



Construction Documents

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Domestic water piping.
  - 2. HVAC duct.
  - 3. HVAC piping.
  - 4. Electrical conduit.
  - 5. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. HVAC diffusers.
    - c. Fire alarm devices.
    - d. Electrical Specialties
- D. Qualification Data: For qualified Installer and design professionals.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Welding certificates.
- G. Fire-hydrant flow test report.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

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Construction Documents

- a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."

1.8 PROJECT CONDITIONS

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

1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

Construction Documents

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40, Galvanized and Black Steel Pipe: ASTM A 135; ASTM A 795/A 795M, or ASME B36.10M, wrought steel; Pipe ends may be factory or field formed to match joining method.

- A. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M. Pipe ends may be factory or field formed to match joining method. d smaller.

- B. Malleable- or Ductile-Iron Unions: UL 860.

- C. Cast-Iron Flanges: ASME 16.1, Class 125.

- D. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

- E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

- F. Grooved-Joint, Steel-Pipe Appurtenances:

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

- a. Anvil International, Inc.
- b. Corcoran Piping System Co.
- c. National Fittings, Inc.
- d. Shurjoint Piping Products.
- e. Tyco Fire & Building Products LP.
- f. Victaulic Company.
- g. Viking Corporation

- 2. Pressure Rating: 175 psig minimum.

- 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

- 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

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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.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be UL listed or FM approved.
  - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
  - 3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.
- B. Ball Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. Victaulic Company.
    - c. Nibco
  - 2. Standard: UL 1091 except with ball instead of disc.
  - 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  - 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  - 5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Iron Butterfly Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
    - a. Anvil International, Inc.
    - b. Fivalco Inc.
    - c. Global Safety Products, Inc.
    - d. Kennedy Valve; a division of McWane, Inc.

Construction Documents

- e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Pratt, Henry Company.
  - h. Shurjoint Piping Products.
  - i. Tyco Fire & Building Products LP.
  - j. Victaulic Company.
2. Standard: UL 1091.
  3. Pressure Rating: 175 psig.
  4. Body Material: Cast or ductile iron.
  5. Style: Lug or wafer.
  6. End Connections: Grooved.
- D. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
    - a. AFAC Inc.
    - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - c. Anvil International, Inc.
    - d. Clow Valve Company; a division of McWane, Inc.
    - e. Crane Co.; Crane Valve Group; Crane Valves.
    - f. Crane Co.; Crane Valve Group; Jenkins Valves.
    - g. Crane Co.; Crane Valve Group; Stockham Division.
    - h. Fire-End & Croker Corporation.
    - i. Fire Protection Products, Inc.
    - j. Fivalco Inc.
    - k. Globe Fire Sprinkler Corporation.
    - l. Groeniger & Company.
    - m. Kennedy Valve; a division of McWane, Inc.
    - n. Matco-Norca.
    - o. Metraflex, Inc.
    - p. Milwaukee Valve Company.
    - q. Mueller Co.; Water Products Division.
    - r. NIBCO INC.
    - s. Potter Roemer.
    - t. Reliable Automatic Sprinkler Co., Inc.
    - u. Shurjoint Piping Products.
    - v. Tyco Fire & Building Products LP.
    - w. United Brass Works, Inc.
    - x. Venus Fire Protection Ltd.
    - y. Victaulic Company.
    - z. Viking Corporation.
    - aa. Watts Water Technologies, Inc.
  2. Standard: UL 312.

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Construction Documents

3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Clow Valve Company; a division of McWane, Inc.
  - d. Crane Co.; Crane Valve Group; Crane Valves.
  - e. Crane Co.; Crane Valve Group; Jenkins Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. Hammond Valve.
  - h. Milwaukee Valve Company.
  - i. Mueller Co.; Water Products Division.
  - j. NIBCO INC.
  - k. Shurjoint Piping Products.
  - l. Tyco Fire & Building Products LP.
  - m. United Brass Works, Inc.
  - n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

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Construction Documents

G. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Fivalco Inc.
  - c. Global Safety Products, Inc.
  - d. Kennedy Valve; a division of McWane, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Shurjoint Piping Products.
  - h. Tyco Fire & Building Products LP.
  - i. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

H. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Clow Valve Company; a division of McWane, Inc.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. Mueller Co.; Water Products Division.
  - g. NIBCO INC.
  - h. Tyco Fire & Building Products LP.

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Construction Documents

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Non-rising.
6. End Connections: Flanged or grooved.

I. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Clow Valve Company; a division of McWane, Inc.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Kennedy Valve; a division of McWane, Inc.
  - f. Mueller Co.; Water Products Division.
  - g. NIBCO INC.
  - h. Tyco Fire & Building Products LP.

2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Wrench or Hand Wheel.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. NIBCO

C. Ball Valves:



Construction Documents

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. Affiliated Distributors.
  - b. Anvil International, Inc.
  - c. Barnett.
  - d. Conbraco Industries, Inc.; Apollo Valves.
  - e. Fire-End & Croker Corporation.
  - f. Fire Protection Products, Inc.
  - g. Flowserve.
  - h. FNW.
  - i. Jomar International, Ltd.
  - j. Kennedy Valve; a division of McWane, Inc.
  - k. Kitz Corporation.
  - l. Legend Valve.
  - m. Metso Automation USA Inc.
  - n. Milwaukee Valve Company.
  - o. NIBCO INC.
  - p. Potter Roemer.
  - q. Red-White Valve Corporation.
  - r. Southern Manufacturing Group.
  - s. Stewart, M. A. and Sons Ltd.
  - t. Tyco Fire & Building Products LP.
  - u. Victaulic Company.
  - v. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Fire Protection Products, Inc.
  - b. United Brass Works, Inc.
  - c. NIBCO

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
  - b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.

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Construction Documents

4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Riser Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Globe Fire Sprinkler Corporation.
  - c. Reliable Automatic Sprinkler Co., Inc.
  - d. Tyco Fire & Building Products LP.
  - e. Venus Fire Protection Ltd.
  - f. Victaulic Company.
  - g. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.

Construction Documents

- d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
2. Standard: UL 405.
  3. Type: Exposed, projecting, for wall mounting.
  4. Pressure Rating: 175 psig minimum.
  5. Body Material: Corrosion-resistant metal.
  6. Inlets: 2.5” Brass Siamese Connection in accordance of local AHJ requirements
  7. Cap: Lugged type, with gasket and chain.
  8. Escutcheon Plate: Round, brass, wall type.
  9. Outlet: Back, with pipe threads.
  10. Number of Inlets: One.
  11. Escutcheon Plate Marking: Similar to AUTO SPKR & STANDPIPE
  12. Finish: Rough aluminum.
  13. Outlet Size: NPS 4.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
  - a. Anvil International, Inc.
  - b. National Fittings, Inc.
  - c. Shurjoint Piping Products.
  - d. Tyco Fire & Building Products LP.
  - e. Victaulic Company.
  - f.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - a. AGF Manufacturing Inc.

Construction Documents

- b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Potter Signal
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  3. Pressure Rating: 175 psig minimum.
  4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  5. Size: Same as connected piping.
  6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AGF Manufacturing Inc.
  - b. Triple R Specialty.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psi minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.9 SPRINKLERS

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

1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.

B. General Requirements:

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Construction Documents

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
- 1.
  2. Nonresidential Applications: UL 199
  3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
1. Characteristics:
    - a. Nominal 1/2-inch Orifice: With Discharge Coefficient K 5.6
- E. Sprinkler Finishes:
1. Chrome plated.
  2. Bronze.
  3. Painted.
- F. Special Coatings:
1. Wax.
  2. Lead.
  3. Corrosion-resistant paint.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting-Recessed: Chrome-plated steel, semi-recessed.
  2. Ceiling Mounted-Concealed: White cover plate
  3. Sidewall Mounting: Chrome-plated steel, semi-recessed.
- H. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  2. Standard: UL 199.

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Construction Documents

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.

- B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:

- a. Fire-Lite Alarms, Inc.; a Honeywell company.
- b. Notifier; a Honeywell company.
- c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

- C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:

- a. ADT Security Services, Inc.
- b. McDonnell & Miller; ITT Industries.
- c. Potter Electric Signal Company.
- d. System Sensor; a Honeywell company.
- e. Viking Corporation.
- f. Watts Industries (Canada) Inc.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

- D. Valve Supervisory Switches:

Construction Documents

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. AMETEK; U.S. Gauge Division.
  2. Ashcroft, Inc.
  3. Brecco Corporation.
  4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building.

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Construction Documents

- B. Install reduced pressure detector backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- N. Fill sprinkler system piping with water.



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Construction Documents

- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. 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.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

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Construction Documents

- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install RPDA backflow preventers instead of check valves in potable-water-supply sources.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

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Construction Documents

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Coordinate with fire-alarm tests. Operate as required.
5. Coordinate with fire-pump tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; grooved ends joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller shall be one of the following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 8 shall be the following:

1. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers, Concealed sprinklers as indicated].

Construction Documents

3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
3. Upright Sprinklers: Rough brass
4. Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 210000

Construction Documents

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

**Content Requests:**

[<Double click here to submit questions, comments, or suggested edits to this Section.>](#)

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 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.

Construction Documents

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 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 220513

Construction Documents

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packless expansion joints.
2. Alignment guides and anchors.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

A. Rubber Union Connector Expansion Joints:

1. Material: Twin reinforced-rubber spheres
2. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
3. End Connections for NPS 2 and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints:

1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
3. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
  - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
4. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
  - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

Construction Documents

5. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
  6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
- C. Externally Pressurized Metal-Bellows Packless Expansion Joints:
1. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
  2. Description:
    - a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
    - b. Carbon-steel housing.
    - c. Drain plugs and lifting lug for NPS 3 and larger.
    - d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
    - e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
    - f. Joint Axial Movement: 4 inches of compression and 0.75 inch of extension.
  3. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
  4. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

2.3 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.
- B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A36/A36M.
  2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
  3. Washers: ASTM F844, steel, plain, flat washers.
  4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Stud: Threaded, zinc-coated carbon steel.
    - b. Expansion Plug: Zinc-coated steel.



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- c. Washer and Nut: Zinc-coated steel.
- 5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 INSTALLATION OF ALIGNMENT-GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

Construction Documents

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

Construction Documents

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

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2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel or Stainless steel or Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 or Stainless steel or Stainless steel, Type 316 of length required to secure pressure plates to sealing elements and compatible with pressure plate material

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, 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.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Sherwin-Williams Company (The).
    - c. The Dow Chemical Company.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, following:
    - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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Construction Documents

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. The below section is superseded by the UL penetration details related to any penetrations of rated floors, ceiling, walls or other assemblies. Refer to relevant U.L. penetration detail on plans for information.
- B. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- C. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch-annular clear space between piping and concrete slabs and walls.
- D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout or silicone sealant, 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.
- F. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

Construction Documents

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves.
    - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. PVC pipe sleeves where not in a return plenum. Use Cast Iron sleeves in any return plenums.

Construction Documents

5. PVC pipe sleeves where not in a return plenum. Use Cast Iron sleeves in any return plenums

END OF SECTION 220517





Construction Documents

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 ACTION SUBMITTALS

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

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, the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Mid-America Fittings, Inc.
3. ProFlo; a Ferguson Enterprises, Inc. brand.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 ESCUTCHEONS

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

Construction Documents

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.
    - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

Construction Documents

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 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 smaller than or equal to NPS 6.

Construction Documents

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 BRASS BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. KITZ Corporation.
  - c. WATTS.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: 316 Stainless.
  - h. Ball: 316 Stainless.
  - i. Port: Full.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description:

Construction Documents

- a. Standard: MSS SP-110 or MSS-145.
- b. CWP Rating: 600 psig.
- c. Body Design: Two piece.
- d. Body Material: Bronze.
- e. Ends: Threaded and soldered.
- f. Seats: PTFE.
- g. Stem: Bronze or brass.
- h. Ball: Chrome-plated brass.
- i. Port: Full.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Locate valves for easy access and provide separate support where necessary.
- B. Install valves in position to allow full stem movement.

3.2 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 NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 4 and Smaller:
  - 1. Brass ball valves, two-piece with full port and brass trim. Provide with threaded or solder-joint ends.
  - 2. Bronze ball valves, two-piece with port and bronze or brass trim. Provide with threaded or solder-joint ends.
  - 3. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.

END OF SECTION 220523.12



Construction Documents

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

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 B16.18 for solder joint.
3. ASME B31.9 for building services piping valves.

C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

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 Bypass and Drain Connections: MSS SP-45.

Construction Documents

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. NIBCO INC.
  - c. WATTS.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B62, bronze.
  - e. Ends: Threaded or soldered. See valve schedule articles.
  - f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. NIBCO INC.
  - c. WATTS.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description:
  - a. Standard: MSS SP-80, Type 4.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B62, bronze.
  - e. Ends: Threaded or soldered. See valve schedule articles.
  - f. Disc: PTFE.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Locate valves for easy access and provide separate support where necessary.



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- B. Install valves in position to allow full stem movement.
- C. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

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

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Pump-Discharge Check Valves:
    - a. NPS 4 and Smaller: Bronze swing check valves with nonmetallic or bronze disc.
- 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. NPS 4 and Smaller: Threaded or soldered or press-ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 4 and Smaller:
  - 1. Bronze swing check valves bronze or nonmetallic disc, Class 125, with soldered or threaded end connections.

END OF SECTION 220523.14



Construction Documents

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

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2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

C. Copper Pipe and Tube Hangers:

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

2.3 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig or ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band 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.

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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Hilti, Inc.
    - b. MKT Fastening, LLC.
    - c. Simpson Strong-Tie Co., Inc.

Construction Documents

- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, 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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - c. MKT Fastening, LLC.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Indoor Applications: Zinc-coated or stainless steel.
  3. Outdoor Applications: Stainless steel.

2.5 PIPE-POSITIONING SYSTEMS

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

2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

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Construction Documents

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. 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.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

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- J. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - 5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

**3.3 EQUIPMENT SUPPORTS**

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

**3.4 METAL FABRICATIONS**

- A. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

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- B. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.5 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.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.



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- H. Use thermal hanger-shield inserts for insulated piping and tubing.
  
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 6. For suspension of non-insulated stationary pipes NPS 1/2 to NPS 8, the following are permissible:
    - a. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
    - b. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
    - c. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
    - d. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
    - e. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
    - f. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
  
- K. 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 of 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.
  
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

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1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

Construction Documents

END OF SECTION 220529



Construction Documents

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Craftmark Pipe Markers.
  - b. Kolbi Pipe Marker Co.
  - c. Seton Identification Products; a Brady Corporation company.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
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. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. Craftmark Pipe Markers.
  - b. Kolbi Pipe Marker Co.
  - c. Seton Identification Products; a Brady Corporation company.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  3. Letter Color: Black
  4. Background Color: White
  5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  7. 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.
  8. Fasteners: Stainless-steel rivets or self-tapping screws.
  9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Brady Corporation.
  2. Craftmark Pipe Markers.
  3. Seton Identification Products; a Brady Corporation company.
  4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

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- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. Brady Corporation.
  - 2. Champion America.
  - 3. Kolbi Pipe Marker Co.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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: Size letters according to ASME A13.1 for piping.

PART 3 - EXECUTION

3.1 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

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- B. Locate equipment labels where accessible and visible.

3.2 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

- B. Pipe Label Locations: 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 and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

- C. Pipe Label Color Schedule:

1. Domestic Water Piping
  - a. Background: Safety green.
  - b. Letter Colors: White.
2. Sanitary Waste and Storm Drainage Piping:
  - a. Background Color: Safety gray.
  - b. Letter Color: Black.

END OF SECTION 220553



Construction Documents

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Roof drains and rainwater leaders.
4. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.4 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

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- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.5 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "General Plumbing Notes" for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Pittsburgh Corning Corporation.
    - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Preformed Pipe Insulation: Type II, Class 1, without jacket.
  - 3. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ jacket.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Manson Insulation Inc.
    - c. Owens Corning.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
  - 2. Preformed Pipe Insulation: Type I, Grade A, without factory-applied jacket.
  - 3. 850 deg F.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Armacell LLC.
    - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

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- a. Foster Brand; H. B. Fuller Construction Products.
  - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Armacell LLC.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. K-Flex USA.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  3. Wet Flash Point: Below 0 deg F.
  4. Service Temperature Range: 40 to 200 deg F.
  5. Color: Black.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Dow Consumer Solutions.

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- b. Johns Manville; a Berkshire Hathaway company.
- c. P.I.C. Plastics, Inc.
- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  - 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. Color: White.

2.4 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 4. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller Construction Products.
  - c. Mon-Eco Industries, Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.5 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Vimasco Corporation.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Johns Manville; a Berkshire Hathaway company.
  - b. P.I.C. Plastics, Inc.
  - c. Proto Corporation.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system. Color as selected by Architect.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
  - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
6. Factory-Fabricated Fitting Covers:
  - a. Same material, finish, and thickness as jacket.
  - b. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - c. Tee covers
  - d. Flange and union covers.
  - e. End caps.
  - f. Beveled collars.
  - g. Valve covers.
  - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

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- a. Avery Dennison Corporation, Specialty Tapes Division.
  - b. Ideal Tape Co., Inc., an American Biltrite Company.
  - c. Knauf Insulation.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Width: 3 inches.
  3. Thickness: 11.5 mil.
  4. Adhesion: 90 ounces force/inch-in width.
  5. Elongation: 2-percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Knauf Insulation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  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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D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Avery Dennison Corporation, Specialty Tapes Division.
  - b. Ideal Tape Co., Inc., an American Biltrite Company.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
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.

2.8 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

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

C. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. C & F Wire.
  - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Buckaroos, Inc.
  - b. Zurn Industries, LLC.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Truebro.
  - b. Zurn Industries, LLC.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

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- H. Install insulation with least number of joints practical.
- 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. 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, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- K. Cut insulation in a manner to avoid compressing insulation more than 25 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 in similar fashion to butt joints.
- N. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

3.3 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.

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3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 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, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and

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- 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  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.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

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4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe 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 that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

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2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

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

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

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1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.



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1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

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

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 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.
    - a. Sanitary sewer and storm drainage piping located in unconditioned parking garages need only p-traps insulated unless otherwise notes.
      - 1) Greasy waste piping in unconditioned parking garages to be insulated and heat taped.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
  - 4. Backflow preventers.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
    - c. Polyolefin: 3/4 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch-thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch-thick.
    - c. Polyolefin: 3/4 inch-thick.
- C. Stormwater and Overflow:

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

D. Roof Drain and Overflow Drain Bodies:

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

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

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1/2 inch thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - c. Polyolefin: 3/4 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  1. None.
- D. Piping, Exposed:
  1. None.
  2. PVC: 20 mils thick.
  3. Aluminum, Smooth: 0.016 inch thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

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

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1. None.
2. PVC: 20 mils thick.
3. Aluminum, Smooth: 0.016 inch thick.
4. Painted Aluminum, Smooth: 0.016 inch thick.

D. Piping, Exposed:

1. PVC: 20 mils thick.
2. Painted Aluminum, Smooth: 0.016 inch thick.

3.16 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

Construction Documents

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. CPVC piping.
3. PEX tube and fittings.
4. Piping joining materials.
5. Transition fittings.
6. Dielectric fittings.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B88, Type L.
- B. Soft Copper Tube: ASTM B88, Type K and ASTM B88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast 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.
- G. Wrought Copper Unions: ASME B16.22.
- H. Copper Tube, Pressure-Seal-Joint Fittings:

Construction Documents

1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
2. Minimum 200-psig working-pressure rating at 250 deg F.

I. Copper Tube, Push-on-Joint Fittings:

1. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
2. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 CPVC PIPING

A. CPVC Pipe: ASTM F441/F441M, schedule 40 and schedule 80.

1. CPVC Socket Fittings: ASTM F438 for Schedule 40 and ASTM F439 for Schedule 80.
2. CPVC Threaded Fittings: ASTM F437, Schedule 80.

B. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.

2.4 PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Apollo Valves; a part of Aalberts Integrated Piping Systems.
2. Watts Radiant; A WATTS Brand.
3. Zurn Industries, LLC.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Tube Material: PEX plastic according to ASTM F876 and ASTM F877.

C. Fittings: ASTM F1807, metal insert and copper crimp rings.

D. Push-Fit Fittings: ASSE 1061, push-fit fittings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. SharkBite, A Division of Reliance Worldwide Corporation.
- b. Zurn Industries, LLC.
- c. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

- E. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- ~~G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.~~
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 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. Plastic-to-Metal Transition Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Spears Manufacturing Company.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

2. Description:
  - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
  - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. [Colonial Engineering, Inc.](#)
  - b. [NIBCO INC.](#)
  - c. [Spears Manufacturing Company.](#)
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description:
  - a. CPVC four-part union.
  - b. Brass or stainless steel threaded end.
  - c. Solvent-cement-joint or threaded plastic end.
  - d. Rubber O-ring.
  - e. Union nut.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. [WATTS.](#)
    - b. [Wilkins.](#)
    - c. [Zurn Industries, LLC.](#)
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 250 psig.
  4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:



Construction Documents

- a. [WATTS.](#)
  - b. [Wilkins.](#)
  - c. [Zurn Industries, LLC.](#)
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 175 psig-
  5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. [Advance Products & Systems, Inc.](#)
    - b. [Calpico, Inc.](#)
    - c. [Central Plastics Company.](#)
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig.
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. [Grinnell G-Fire by Johnson Controls Company.](#)
    - b. [Matco-Norca.](#)
    - c. [Precision Plumbing Products.](#)
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Standard: IAPMO PS 66.
  3. Electroplated steel nipple complying with ASTM F1545.
  4. End Connections: Male threaded or grooved.
  5. Lining: Inert and noncorrosive, propylene.

Construction Documents

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 and smaller, shall be one of the following:
  - 1. Soft copper tube, ASTM B88, Type K or ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or copper pressure-seal fittings; and pressure-sealed joints.
  - 2. CPVC, Schedule 40 ; socket fittings; and solvent-cemented joints.
- E. Under-building-slab, domestic water piping, NPS4 and smaller, shall be one of the following:
  - 1. Hard or soft copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 2. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
- F. Aboveground domestic water piping, NPS 4 and smaller, shall be-one of the following:
  - 1. Hard copper tube, ASTM B88, Type L or ASTM B88, Type M; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
  - 2. Hard copper tube, ASTM B88, Type L or ASTM B88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. Hard copper tube, ASTM B88, Type L or ASTM B88, Type M; copper push-on-joint fittings; and push-on joints.
  - 4. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
  - 5. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
  - 6. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.
  - 7. PEX tube, NPS 1 and smaller.
    - a. Fittings for PEX tube:
      - 1) ASTM F1807, metal insert and copper crimp rings.
      - 2) ASTM F1960, cold expansion fittings and reinforcing rings.
      - 3) ASSE 1061, push-fit fittings.

Construction Documents

3.2 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. 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 valves according to the following:
  - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
  - 2. Section 220523.14 "Check Valves for Plumbing Piping."
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on inlet and outlet piping from each water heater.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Construction Documents

- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. 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.
- H. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
- I. Joints for PEX Tubing, ASTM: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- J. Joints for PEX Tubing, ASSE: Join according to ASSE 1061 for push-fit fittings.
- K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

Construction Documents

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- 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 unions.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper, ductile iron, and galvanized steel tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install vinyl-coated hangers for CPVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of copper and stainless steel tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of CPVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

Construction Documents

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

3.9 IDENTIFICATION

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

3.10 ADJUSTING

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

3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

Construction Documents

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

3.12 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.

Construction Documents

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116



Construction Documents

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer device.

B. Related Requirements:

1. Section 221116 "Domestic Water Piping" for water meters.
2. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

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

Construction Documents

2.3 VACUUM BREAKERS

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

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers (BFP):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1013.
3. See plumbing fixture schedule for more information.
4. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators (PRV-1)

1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1003.
3. See plumbing fixture schedule for more information.

Construction Documents

2.6 BALANCING VALVES

A. Memory-Stop Balancing Valves (PRV-1)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. Milwaukee Valve Company.
  - c. Watts.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: NSF 61 Health Effects Annex G
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Lead Free Brass.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves (TV-1, TV-2)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1070 and ASSE 1017 .
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. See plumbing fixture schedule for more information.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. Titan Flow Control, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
  3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
  4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  5. Screen: Stainless steel with round perforations unless otherwise indicated.
  6. Perforation Size:
    - a. Strainers NPS 2 and Smaller: 0.033 inch
  7. Drain: Pipe plug

2.9 HOSE BIBBS

A. Hose Bibbs: (HB-1, HB-2, FPHB)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. WATTS.
  - b. Woodford Manufacturing Company.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. See plumbing fixture schedule for more information.

2.10 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.

Construction Documents

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.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Sioux Chief Manufacturing Company, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
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.

2.12 TRAP-SEAL PRIMER DEVICE

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

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Zurn Industries, LLC.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.

Construction Documents

- B. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- C. Water-Hammer Arresters: Install in water piping in accordance with drawings.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.4 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Balancing valves.
  - 5. Temperature-actuated, water mixing valves.
  - 6. Wall hydrants.
  - 7. Trap-seal primer device.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and/or double-check, detector-assembly backflow

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preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and/or double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221119





Construction Documents

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. PVC pipe and fittings.
  - 3. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

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

1.3 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 PIPING MATERIALS

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

2.3 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

Construction Documents

C. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- 1) Dallas Specialty & Mfg. Co.
- 2) Fernco Inc.
- 3) Froet Industries LLC.
- 4) Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

- b. Standard: ASTM C 1173.
  - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.
  - e. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
3. Shielded, Nonpressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company, LLC; a division of MCP Industries.
    - 3) Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - b. Standard: ASTM C 1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

Construction Documents

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. 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.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 2-1/2 and smaller; 1 percent downward in direction of flow for piping NPS 3 to 6 and larger. 1/2 percent downward in direction of flow for piping NPS 8 and larger.
  - 2. Horizontal Sanitary Waste Piping: 1 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

Construction Documents

- N. Install aboveground PVC piping according to ASTM D 2665.
- O. Install underground PVC piping according to ASTM D 2321.
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- B. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Unshielded, nonpressure transition couplings.

Construction Documents

3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping,"

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Install supports for vertical PVC piping every 48 inches.
- F. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:

Construction Documents

1. Plumbing Fixtures: Connect waste 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 waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

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

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

**Construction Documents**

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
  - a. 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 waste and vent piping until it has been tested and approved.
  - a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
  - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
  - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
  - c. Inspect joints for leaks.
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.
  - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
  - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
  - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
  - d. 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.

**3.10 CLEANING AND PROTECTION**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.



Construction Documents

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 6 and smaller shall be any of the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 8 and smaller shall be any of the following:
  - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316



Construction Documents

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

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

2.2 CLEANOUTS

- A. Wall Cleanouts (WCO)
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. MIFAB, Inc.
    - b. WATTS.
    - c. Zurn Industries, LLC.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Standard: ASME A112.36.2M. Include wall access.
  - 3. See plumbing fixture schedule for more information
- B. Plastic Floor Cleanouts (FCO)
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. IPS Corporation.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Size: Same as connected branch.
  3. Body: PVC.
  4. Closure Plug: PVC.
  5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.
  6. See plumbing fixture schedule for more information

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch-minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at minimum intervals of 100 feet for piping NPS 6 and smaller.
  3. Locate at base of each vertical soil and waste stack.

**Construction Documents**

- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub 1 inch above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. 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.

**3.2 PIPING CONNECTIONS**

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

**3.3 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

**3.4 PROTECTION**

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

END OF SECTION 221319



Construction Documents

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor drains.

1.2 DEFINITIONS

- A. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

- A. Plastic Floor Drains (FD-1, FD-2):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Oatey.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASME A112.6.3.
3. Material: PVC.

Construction Documents

4. Seepage Flange: Not required.
5. Clamping Device: Not required.
6. Outlet: Bottom
7. Sediment Bucket: Not required.
8. Top or Strainer Material: Bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Round.
11. Trap Material: Plastic drainage piping.
12. Trap Pattern: Standard P-trap.
13. See plumbing fixture schedule for more information.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.

3.2 PROTECTION

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

END OF SECTION 221319.13



Construction Documents

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC pipe and fittings.
2. Specialty pipe and fittings.

B. Related Requirements:

1. Section 334400 "Stormwater Utility Equipment" for storm drainage piping outside the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2.2 PVC PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Charlotte Pipe and Foundry Company.
2. National Pipe and Plastic, Inc.
3. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

- B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- E. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F 656.
- G. Solvent Cement: ASTM D 2564.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

- 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
- 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
- 3. Unshielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - 1) Dallas Specialty & Mfg. Co.
    - 2) Fernco Inc.
    - 3) Mission Rubber Company, LLC; a division of MCP Industries.
    - 4) Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - b. Standard: ASTM C 1173.
  - c. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 4. Shielded, Nonpressure Transition Couplings:

Construction Documents

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1) Cascade Waterworks Mfg. Co.
  - 2) Mission Rubber Company, LLC; a division of MCP Industries.
  - 3) Additional manufacturers submitted for and receiving engineer approval prior to bid.
- b. Standard: ASTM C 1460.
- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- C. Install piping to permit valve servicing.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Install piping to allow application of insulation.
- G. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
  1. Do not change direction of flow more than 90 degrees.
  2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of drainage piping in direction of flow is prohibited.
- H. Install piping at the following minimum slopes unless otherwise indicated:

Construction Documents

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 4 and smaller; 1 percent downward in direction of flow for piping NPS 5 and larger.
  2. Horizontal Storm Drainage Piping: 2 percent downward in direction of flow.
- I. Install aboveground PVC piping according to ASTM D 2665.
  - J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  - K. Install sleeves for piping penetrations of walls, ceilings, and floors.
    1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
  - L. Install sleeve seals for piping penetrations of concrete walls and slabs.
    1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
  - M. Install escutcheons for piping penetrations of walls, ceilings, and floors.
    1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. PVC, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendices.
  3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendices.
- B. Joint Restraints and Sway Bracing:
  1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
    - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
    - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

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Construction Documents

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installations are specified in the following Sections:

1. Section 220523.12 "Ball Valves for Plumbing Piping."
2. Section 220523.14 "Check Valves for Plumbing Piping."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
  - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical PVC piping with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

**Construction Documents**

- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

**3.8 IDENTIFICATION**

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

**3.9 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.

Construction Documents

3. Test Procedure:
  - a. Test storm drainage piping, except outside leaders, on completion of roughing-in.
  - b. 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 until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

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

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 8 and smaller shall be any of the following:
  1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Underground storm drainage piping NPS 8 and smaller shall be any of the following:
  1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221413





Construction Documents

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

**TIPS:**

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To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

**Content Requests:**

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal roof drains.
2. Miscellaneous storm drainage piping specialties.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

Construction Documents

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. MIFAB, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASME A112.6.4.
3. Body Material: Cast iron.
4. Dimension of Body: 8- to 12-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Not required.
6. Outlet: Bottom.
7. Outlet Type: No hub or Inside caulk or Threaded.
8. Dome Material: Aluminum or Cast iron or PE.
9. Wire Mesh: Stainless steel or brass over dome.
10. Perforated Gravel Guard: Stainless steel.
11. Vandal-Proof Dome: Not Required.
12. Water Dam: 2 inches high.
13. See plumbing fixture schedule for more information.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adapters:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. J.R. Hoe & Sons Inc.
  - b. Neenah Foundry Company.
  - c. WATTS.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Manufactured, ASTM A48/A48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
3. Size: Inlet size to match downspout and NPS 4 outlet.

C. Metal Downspout Nozzles:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. [JAY R. SMITH MFG. CO.](#)
  - b. [WATTS.](#)
  - c. [Zurn Industries, LLC.](#)
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor.
  3. Size: Same as connected downspout.
  4. Material: Cast bronze or nickel bronze nozzle and flange.
  5. Piping Connection Type: Threaded or Slip on.
  6. Opening Protection: Birdscreen.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas in accordance with roof membrane manufacturer's written installation instructions.
  1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  2. Install expansion joints, if indicated, in roof drain outlets.
  3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 6 inches or 12 inches above grade. Secure to building wall.
- D. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install test tees in vertical conductors and near floor.
- F. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.2 INSTALLATION OF FLASHING

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.

Construction Documents

- D. Secure flashing into sleeve and specialty clamping ring or device.

3.3 PROTECTION

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

END OF SECTION 221423

Construction Documents

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Residential, electric, storage, domestic-water heaters.
  - 2. Thermostat-control, electric, tankless, domestic-water heaters.
  - 3. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

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

1.3 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. 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."

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Periods: From date of Substantial Completion.
    - a. Residential, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Six years.
      - 2) Controls and Other Components: Six years.
    - b. Electric, Tankless, Domestic-Water Heaters: Five years.
    - c. Expansion Tanks: Five years.

Construction Documents

PART 2 - PRODUCTS

2.1 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Residential, Electric, Storage, Domestic-Water Heaters

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. A. O. Smith Corporation.
  - b. Bradford White Corporation.
  - c. State Industries.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - d. Insulation: Comply with ASHRAE 90.2.
  - e. Jacket: Steel, cylindrical, with enameled finish or high-impact composite material.
  - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
  - g. Heating Elements: Two; electric, screw-in immersion type; wired for non-simultaneous operation unless otherwise indicated. Limited to 12 kW total.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Control: High-temperature-limit cutoff device or system.
  - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics: (WH-1)

1. See plumbing schedules for more information.

Construction Documents

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Bradford White Corporation.
  - b. Bradley Corporation.
  - c. Eemax, Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
3. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 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: Flow-control fitting.
  - 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: (WH-2, WH-6)
  - a. See plumbing schedules.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. A. O. Smith Corporation.
  - b. State Industries.
  - c. TACO Comfort Solutions, Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

Construction Documents

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
- a. Working-Pressure Rating: 150 psig-
  - b. Capacity Acceptable: 2 gal minimum.
  - c. Air Precharge Pressure: 40 psi
- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CAS LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.07 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE 90.2.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.
- F. 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 working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.
- 2.4 SOURCE QUALITY CONTROL
- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.



Construction Documents

- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on water-heater stand on floor, where specified.
  - 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. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters on wall bracket, where specified. Maintain all ADA clearances.
  - 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.
- C. Install electric, domestic-water heaters level and plumb, in accordance with 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,"
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-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 combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-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.

**Construction Documents**

- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters.
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water expansion tanks with air to required system pressure.
- K. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- L. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

**3.2 PIPING 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 FIELD QUALITY CONTROL**

- A. Perform tests and inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

END OF SECTION 223300

Construction Documents

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

**TIPS:**

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, power-burner, gas-fired, storage, domestic-water heaters.
2. Commercial, direct-vent, gas-fired, storage, domestic-water heater.
3. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

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

1.3 COORDINATION

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

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.

- a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

- 1) Storage Tank: Three years.
- 2) Controls and Other Components: Two year(s).

Construction Documents

- b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
- C. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- D. ASME Compliance:
  - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

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

- A. Commercial, Gas-Fired, Storage, Domestic-Water Heaters (WH-3, WH-4):
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:
    - a. A. O. Smith Corporation.
    - b. Aldrich Company, Inc. (The).
    - c. State Industries.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid
  - 2. Standard: ANSI Z21.10.3/CSA 4.3.
  - 3. Storage-Tank Construction: ASME-code steel with 160-psig working-pressure rating.
    - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

Construction Documents

- 1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
- 2) NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
- b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
- c. Lining: Glass complying with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
4. Factory-Installed, Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - d. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
  - e. Jacket: Steel with enameled finish.
  - f. Burner: UL 795 for power-burner, gas-fired, domestic-water heaters and natural-gas fuel.
  - g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
  - h. Temperature Control: Adjustable thermostat.
  - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
  - j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
5. Special Requirements: NSF 5 construction.
6. See plumbing fixture drawings for more information.

2.3 GAS-FIRED, TANKLESS, DOMESTIC-WATER HEATERS (WH-5, WH-5A, WH-7):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. A. O. Smith Corporation.
  - b. Rheem Manufacturing Company.
  - c. State Industries.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid

Construction Documents

2. Standard: ANSI Z21.10.3/CSA 4.3 for gas-fired, instantaneous, domestic-water heaters for indoor application.
3. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Heat Exchanger: Copper tubing or Stainless steel.
  - d. Insulation: Comply with ASHRAE/IES 90.1.
  - e. Jacket: Metal, with enameled finish, or plastic.
  - f. Burner: For use with tankless, domestic-water heaters and natural-gas fuel.
  - g. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
  - h. Temperature Control: Adjustable thermostat.
  - i. Support: Bracket for wall mounting
4. See plumbing fixture drawings for more information.

2.4 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. A. O. Smith Corporation.
  - b. State Industries.
  - c. TACO Comfort Solutions, Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
  - a. Working-Pressure Rating: 150 psig.
  - b. Capacity Acceptable: 4 gal. minimum.
  - c. Air Precharge Pressure: 40 psi

Construction Documents

- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Comply with requirements for ball-, butterfly-, or gate-type 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."
  - 1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.
- G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig or 2-psig pressure rating as required to match gas supply.
- H. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- I. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
  - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- J. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
  - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- K. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- L. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater minimum of [18 inches] <Insert dimension> above the floor.
- M. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

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Construction Documents

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

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



**Construction Documents**

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."
- D. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
  2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
  3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
  4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."
- E. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
- F. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-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.
- G. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- H. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- I. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for 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," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- J. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- K. Fill domestic-water heaters with water.
- L. Charge domestic-water expansion tanks with air to required system pressure.

Construction Documents

- M. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- N. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

END OF SECTION 223400

Construction Documents

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Wall-mounted water closets.
3. Flushometer valves and tanks.
4. Toilet seats.
5. Supports.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets, Floor Mounted, Bottom Outlet, Top Spud (P1-A, P1-B):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. See plumbing fixture schedule for more information:
3. Bowl-to-Drain Connecting Fitting: ASTM A1045 or ASME A112.4.3.

2.2 WALL-MOUNTED WATER CLOSETS

A. Water Closets, Wall Mounted, Top Spud, Accessible (P1-C):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. American Standard.
  - b. Kohler Co.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. See plumbing fixture schedule for more information.
  3. Support: Water closet carrier.
  4. Water-Closet Mounting Height: Handicapped/elderly according to ICC A117.1.

2.3 FLUSHOMETER VALVES

A. Lever-Handle, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1037.
3. See plumbing fixture schedule for more information.

2.4 TOILET SEATS

A. Toilet Seats (P1-A, P1-B, P1-C):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard)
5. Shape: Elongated rim, open front or Elongated rim, closed front.
6. Hinge: Check or Self-sustaining.
7. Hinge Material: Noncorroding metal.
8. See plumbing fixture schedule for more information.

Construction Documents

2.5 SUPPORTS

A. Water Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Zurn Industries, LLC.
  - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Use carrier supports with waste-fitting assembly and seal.
2. 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:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.

Construction Documents

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."

3.2 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.

3.3 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.

3.4 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

Construction Documents

SECTION 224213.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Wall-hung Urinals
  2. Urinal flushometer valves.
  3. Supports.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

- A. Urinals - Wall Hung, Washout, Accessible (P-2).
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. See plumbing fixture schedule for more information.
  3. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5/CSA B45.15.
  4. Waste Fitting:
    - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
    - b. Size: NPS 2.
  5. Support: Urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture
  6. Urinal Mounting Height: Handicapped/elderly according to ICC A117.1.
  7. See plumbing fixture schedule for more information.

Construction Documents

B. Solenoid-Actuator, Diaphragm Flushometer Valves: (P-2)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard.
  - b. Sloan Valve Company.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
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. Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
9. Trip Mechanism: Battery-powered or Hard-wired electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. See plumbing fixture schedule for more information.

2.2 SUPPORTS

A. Urinal Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. MIFAB, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Urinal Installation:

1. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.



Construction Documents

2. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC A117.1.

B. Support Installation:

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

C. Flushometer-Valve Installation:

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

D. Wall Flange and Escutcheon Installation:

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

E. Joint Sealing:

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

3.2 PIPING CONNECTIONS

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

3.3 ADJUSTING

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

Construction Documents

- B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

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

END OF SECTION 224213.16

Construction Documents

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Lavatories.
  - 2. Faucets
  - 3. Supply fittings.
  - 4. Waste fittings.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory - Vitreous China, Undercounter Mounted (P-3A, P-3B)
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. American Standard.
    - b. Kohler Co.
    - c. Zurn Industries, LLC.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. See plumbing fixture schedule for more information:
  - 3. Faucet: See plumbing fixture schedule for more information.
  - 4. Child or Handicapped/elderly lavatories to be installed according to ICC A117.1
    - a. See architectural floor plan for locations

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory - Vitreous China, Wall Mounted, with Back (P-4, P-4A)

Construction Documents

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. See plumbing fixture schedule for more information:
3. Faucet: See plumbing fixture schedule for more information.
4. Child or Handicapped/elderly lavatories to be installed according to ICC A117.1
  - a. See architectural floor plan for locations

2.3 AUTOMATICALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Automatic Type: Battery Powered or Hardwired Electronic Sensor Operated, Mixing (P3A, P3-B, P-4, P-4A)
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Advanced Modern Technologies Corporation - AMTC.
    - b. American Standard.
    - c. Kohler Co.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
  3. 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.
  4. See plumbing fixture schedule for more information.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

Construction Documents

- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
  - 1. NPS 3/8.
  - 2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces.

2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2.
  - 2. Material:
    - a. Stainless steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless steel tube to wall; and stainless 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 supports, affixed to building substrate, for wall-mounted lavatories.

Construction Documents

- B. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- C. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING 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. Install new batteries in battery-powered, electronic-sensor mechanisms at turnover to owner.
- C. Adjust water pressures 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

Construction Documents

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service sinks.
2. Handwash sinks.
3. Kitchen/utility sinks.
4. Manually operated sink faucets.
5. Automatically operated sink faucets.
6. Supply fittings.
7. Waste fittings.
8. Sink Supports.

B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Molded Stone, Floor Mounted (P-5)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Fiat Products.
  - b. Florestone Products Co., Inc.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. See plumbing fixture schedule for more information.
3. Mounting: On floor and flush to wall.

Construction Documents

2.2 KITCHEN/UTILITY SINKS

A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: (P-7)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Advance Tabco.
  - b. Elkay.
  - c. Just Manufacturing.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. See plumbing fixture schedule for more information.
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: Wheel handle.
    - 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:
      - a) Chrome-plated; and chrome-plated brass or steel wall flange.
      - b) Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
5. Mounting: On counter with sealant.

2.3 HANDWASH SINKS

A. Handwash Sinks - Stainless Steel: (P-8, P-9).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Advance Tabco.
  - b. American Standard.
  - c. Eagle Group.



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- d. Elkay.
  - e. Absolute Stone
  - f. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Fixture:
- a. Standards:
    - 1) ASME A112.19.3/CSA B45.4.
    - 2) NSF 61.
3. See plumbing fixture schedule for more information.

2.4 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Single-control mixing and Two-handle mixing.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. American Standard.
    - b. Elkay.
    - c. Kohler Co.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Standard: ASME A112.18.1/CSA B125.1.
  - 3. See plumbing fixture schedule for more information

2.5 AUTOMATICALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Automatic Type: Battery-powered, electronic-sensor-operated, mixing.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Kohler Co.
  - b. Moen Incorporated.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. 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.
4. See plumbing fixture schedule for more information

2.6 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
  1. NPS 3/8.
  2. Chrome-plated, rigid-copper pipe.

2.7 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  1. Size: NPS 1-1/2.
  2. Material:
    - a. Chrome-plated; and chrome-plated brass or steel wall flange.

Construction Documents

- b. Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.8 SINK SUPPORTS

A. Sink Carrier:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. MIFAB, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- 2. Standard: ASME A112.6.1M.

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 supports, affixed to building substrate, for wall-hung sinks.
- B. 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. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"
  - 2. Install stops in locations where they can be easily reached for operation.
- C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

Construction Documents

- D. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

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

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressures 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

Construction Documents

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pressure water coolers and related components.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers (P-10) Wall mounted, wheelchair accessible.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Elkay.
    - b. Halsey Taylor.
    - c. Haws Corporation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Standards:
    - a. Comply with NSF 61 Annex G and NSF 372.
    - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
    - c. Comply with ICC A117.1.
  - 3. Drain: Grid with NPS 1-1/4 tailpiece.
  - 4. Supply: NPS 3/8 with shutoff valve.
  - 5. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
  - 6. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Construction Documents

7. Support: Water cooler carrier.
8. Water Cooler Mounting Height: Handicapped/elderly according to ICC A117.1.
9. See plumbing fixture schedules for more information.

B. Water Cooler Carriers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. MIFAB, Inc.
  - b. WATTS.
  - c. Zurn Industries, LLC.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: ASME A112.6.1M.

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. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install mounting frames, affixed to building construction, and attach in-wall, bottle filling stations to mounting frames.
- ~~D.~~ 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"
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

Construction Documents

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

3.3 CONNECTIONS

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

3.4 ADJUSTING

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

3.5 CLEANING

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

END OF SECTION 224716





Construction Documents

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 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.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.

Construction Documents

- 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. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
  - 1. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- 1. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

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

Construction Documents

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513



Construction Documents

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.
4. 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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

Construction Documents

- E. PVC Pipe Sleeves: ASTM D1785, Schedule 40. PVC pipe sleeves are not to be used in return plenums.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

- B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Composite plastic.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, 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.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

Construction Documents

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. GE Construction Sealants; Momentive Performance Materials Inc.
  - b. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
  - c. Sherwin-Williams Company (The).
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  2. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

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Construction Documents

- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls Above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves.
  - 2. Exterior Concrete Walls Below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs Above Grade:
    - a. Piping Smaller Than NPS 6: Steel-pipe sleeves.
  - 5. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Galvanized-steel pipe sleeves.

END OF SECTION 230517



Construction Documents

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 ACTION SUBMITTALS

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

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:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Keeney Manufacturing Company (The).
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 ESCUTCHEONS

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

2.3 FLOOR PLATES

- A. Split Floor Plates: Steel with concealed hinge.

Construction Documents

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 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.
    - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece stamped steel with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: Split floor plate.
  - 2. Existing Piping to Remain: Split floor plate.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 230518

Construction Documents

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

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

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 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, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

Construction Documents

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

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

2.3 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. Eaton (B-line).
  - b. Hilti, Inc.
  - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.4 EQUIPMENT SUPPORTS

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

2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

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Construction Documents

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- E. Fastener System Installation:
  1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

Construction Documents

- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

Construction Documents

- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

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

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 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.

3.6 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.

Construction Documents

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers and fiberglass strut systems and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.



**Construction Documents**

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

**Construction Documents**

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

Construction Documents

- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use-mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529



Construction Documents

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. Marking Services, Inc.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 3. Letter Color: White.
  - 4. Background Color: Blue.
  - 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.

Construction Documents

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

- a. Brady Corporation.
- b. Carlton Industries, LP.
- c. Marking Services, Inc.
- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

3. Letter Color: White.

4. Background Color: Blue.

5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

7. 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.

8. Fasteners: Stainless-steel rivets or self-tapping screws.

9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

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

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Marking Services Inc.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

Construction Documents

- C. Letter Color: White.
- ~~D.~~ Background Color: Red.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. 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.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

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.

END OF SECTION 230553





Construction Documents

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

**Content Requests:**

[<Double click here to submit questions, comments, or suggested edits to this Section.>](#)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
  - a. Constant-volume air systems.
  - b. Variable-air-volume systems.
2. Testing, adjusting, and balancing of equipment.
3. Duct leakage tests verification.
4. HVAC-control system verification.

1.2 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 independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

Construction Documents

1.3 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.
- B. 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.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.

\*\*\*\*\* [OR] \*\*\*\*\*
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

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 installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.

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Construction Documents

- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. 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.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.

Construction Documents

- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

- 1. Airside:
  - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
  - b. Duct systems are complete with terminals installed.
  - c. Volume, smoke, and fire dampers are open and functional.
  - d. Clean filters are installed.
  - e. Fans are operating, free of vibration, and rotating in correct direction.
  - f. Automatic temperature-control systems are operational.
  - g. Ceilings are installed.
  - h. Windows and doors are installed.
  - i. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance"-and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings 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. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping 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 (IPunits).

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Motors.
  - 2. Fans and ventilators.
  - 3. Air curtains.
  - 4. Terminal units.

Construction Documents

5. Commercial kitchen hoods.
6. Unit heaters.
7. Air-handling units.
8. Heating and ventilating units.
9. Rooftop air-conditioning units.
10. Dedicated outdoor-air units.
11. Packaged air conditioners.
12. Self-contained air conditioners.
13. Split-system air conditioners.
14. Heat pumps.
15. Unit ventilators.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

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

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

Construction Documents

- b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Obtain approval from Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
  1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.
  3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
  4. Mark all final settings.
  5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  6. Measure and record all operating data.
  7. Record final fan-performance data.

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3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
  - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
  - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
  - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
  - d. Adjust controls so that terminal is calling for minimum airflow.
  - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
  - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
  - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
  - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
  - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
6. Measure fan static pressures as follows:
  - a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.

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- c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
- 7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Balance the return-air ducts and inlets.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
- 8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
- 9. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.

3.8 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Phase and hertz.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter size and thermal-protection-element rating.
  - 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.



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- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

3.10 PROCEDURES FOR AIR-COOLED CONDENSERS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of fan(s) and motor(s).
- E. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Air pressure drop.
  - 5. Voltage and amperage input of each phase at full load.
  - 6. Calculated kilowatt at full load.
  - 7. Fuse or circuit-breaker rating for overload protection.
- F. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Entering and leaving refrigerant pressure and temperatures.

3.11 PROCEDURES FOR EXHAUST HOODS

- A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent space with hoods in room initially not operating and then with hoods operating.
- B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of exhaust hoods.
  - 1. Measure and record temperature of makeup air entering hood. If hood makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.
  - 2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of hoods. Consult with hood manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.
- C. Kitchen Hoods:

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1. Type 1: Measure and record pressure drop and face velocity of hood filters and slots in accordance with hood manufacturer's instructions. Consult hood manufacturer to determine hood airflow using recorded information.
2. Type 2: Measure and record airflow by duct traverse.
3. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

D. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

3.12 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.13 HVAC CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  1. Verify HVAC control system is operating within the design limitations.
  2. Confirm that the sequences of operation are in compliance with Contract Documents.
  3. Verify that controllers are calibrated and function as intended.
  4. Verify that controller set points are as indicated.
  5. Verify the operation of lockout or interlock systems.
  6. Verify the operation of valve and damper actuators.
  7. Verify that controlled devices are properly installed and connected to correct controller.
  8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.14 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
  2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.

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- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.15 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

3.16 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.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following as applicable:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; 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 specialist.
  - 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 performance forms, including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Heating coil, dry-bulb conditions.
  - e. Face and bypass damper settings at coils.
  - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
  - g. Variable-frequency controller or Inlet vane settings for variable-air-volume systems.
  - h. Settings for pressure controller(s).
  - i. Other system operating conditions that affect performance.
- 16. Test conditions for pump performance forms, including the following:
  - a. Variable-frequency controller settings for variable-flow hydronic systems.
  - b. Settings for pressure controller(s).
  - c. 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. Water and steam flow rates.
  - 3. Duct, outlet, and inlet sizes.
  - 4. Pipe and valve sizes and locations.
  - 5. Terminal units.
  - 6. Balancing stations.
  - 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
  - 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.

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- j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  - 2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan speed.
    - d. Inlet and discharge static pressure in inches wg.
    - e. For each filter bank, filter static-pressure differential in inches wg.
    - f. Preheat-coil static-pressure differential in inches wg.
    - g. Cooling-coil static-pressure differential in inches wg.
    - h. Heating-coil static-pressure differential in inches wg.
    - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
    - j. Outdoor airflow in cfm.
    - k. Return airflow in cfm.
    - l. Outdoor-air damper position.
    - m. Return-air damper position.
- F. Apparatus-Coil Test Reports:
  - 1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft..
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.

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- e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.
  - n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig.
- G. Gas- and Oil-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 speed.
    - 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 airflow rate in cfm.
    - b. Entering-air temperature in deg F.
    - c. Leaving-air temperature in deg F.
    - d. Air temperature differential in deg F.
    - 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.

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H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:
  - a. System identification.
  - b. Location.
  - c. Coil identification.
  - d. Capacity in Btu/h.
  - e. Number of stages.
  - f. Connected volts, phase, and hertz.
  - g. Rated amperage.
  - h. Airflow rate in cfm.
  - i. Face area in sq. ft..
  - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
  - a. Heat output in Btu/h.
  - b. Airflow rate in cfm.
  - c. Air velocity in fpm.
  - d. Entering-air temperature in deg F.
  - e. Leaving-air temperature in deg F.
  - f. Voltage at each connection.
  - g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and speed.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

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- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan speed.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, 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 fan 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 airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- K. 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. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:



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- a. System and air-handling-unit identification.
  - b. Location and zone.
  - c. Room or riser served.
  - d. Coil make and size.
  - e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Entering-water temperature in deg F.
  - c. Leaving-water temperature in deg F.
  - d. Water pressure drop in feet of head or psig.
  - e. Entering-air temperature in deg F.
  - f. Leaving-air temperature in deg F.
- M. Instrument Calibration Reports:
1. Report Data:
- a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.
- 3.17 VERIFICATION OF TAB REPORT
- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
  - B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
  - C. 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."
  - D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
  - E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
    - 1. TAB specialists shall 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. All changes shall be tracked to show changes made to previous report.

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2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

- F. Prepare test and inspection reports.

END OF SECTION 230593

Construction Documents

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and return located in unconditioned space.
  - 2. Indoor, concealed supply and return located outside of building envelope.
  - 3. Indoor, concealed outside air.
  
- B. Related Sections:
  - 1. Section 230716 "HVAC Equipment Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."
  - 3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors in Return Plenums: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
  
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
  
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

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- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290,--Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. CertainTeed Insulation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation-with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Eagle Bridges - Marathon Industries.
    - b. Knauf Insulation.
    - c. Mon-Eco Industries, Inc.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Color: To match duct/insulation is visible otherwise White.

2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Eagle Bridges - Marathon Industries.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 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.

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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 C1136, Type II.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.7 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Compac Corporation.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Knauf Insulation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 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.

2.8 SECUREMENTS

- A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.
    - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Insulation Pins and Hangers:

Construction Documents

1. 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - 1) AGM Industries, Inc.
    - 2) Gemco.
    - 3) Hardcast; a Carlisle Company.
    - 4) Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 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.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - 1) Gemco.
    - 2) Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - 1) AGM Industries, Inc.
    - 2) Gemco.

Construction Documents

- 3) Hardcast; a Carlisle Company.
      - 4) Additional manufacturers submitted for and receiving engineer approval prior to bid.
    - 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.
  - 4. 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Midwest Fasteners, Inc.
      - 4) Additional manufacturers submitted for and receiving engineer approval prior to bid.
    - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  - 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
      - 1) Gemco.
      - 2) Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
  - D. Wire: 0.062-inch soft-annealed, stainless steel.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
      - a. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- 2.9 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.



Construction Documents

- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

Construction Documents

- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 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.

Construction Documents

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- 3.4 INSTALLATION OF MINERAL-FIBER INSULATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions. Adhesive may be omitted from the top surface of horizontal rectangular ducts.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment.

## Construction Documents

Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions. Adhesive may be omitted from the top surface of horizontal rectangular ducts.
  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.

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Construction Documents

- 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 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. 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.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.6 FINISHES

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

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

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Construction Documents

- C. Do not field paint aluminum or stainless-steel jackets.

3.7 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

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

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation in Unconditioned Space: Mineral-fiber blanket, 2 inches thick and 1-lb/cu. ft. nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation in Unconditioned Space: Mineral-fiber blanket, 2 inches thick and 1-lb/cu. ft. nominal density.
- C. Concealed, Supply-Air Duct and Plenum Insulation Outside of Building Envelope: Mineral-fiber blanket, 3 inches thick and 0.75-lb/cu. ft. nominal density.
- D. Concealed, Return-Air Duct and Plenum Insulation Outside of Building Envelope: Mineral-fiber blanket, 3 inches thick and 0.75-lb/cu. ft. nominal density.
- E. Concealed, Outside-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.9 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.

Construction Documents

- C. Ducts and Plenums, Concealed:
  - 1. Aluminum, Smooth: 0.020 inch thick.

END OF SECTION 230713





Construction Documents

SECTION 231123 - FACILITY NATURAL-GAS PIPING

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

**Content Requests:**

[<Double click here to submit questions, comments, or suggested edits to this Section.>](#)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric unions.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 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.

Construction Documents

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less where indicated on plans.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.

Construction Documents

2. End Connections: Threaded ends for NPS 2 and smaller.
  3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  1. CWP Rating: 125 psig.
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. BrassCraft Manufacturing Co.; a Masco company.
    - c. Lyall, R. W. & Company, Inc.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. Dormont; a WATTS brand.
  - b. Eclipse Innovative Thermal Technologies.
  - c. Invensys.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

Construction Documents

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: Coordinate with Natural Gas utility.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. Dormont; a WATTS brand.
  - b. Eaton.
  - c. Maxitrol Company.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. HART Industrial Unions, LLC.
  - b. WATTS.
  - c. Wilkins.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description:
  - a. Standard: ASSE 1079.
  - b. Pressure Rating: 125 psig minimum at 180 deg F.
  - c. End Connections: Solder-joint copper alloy and threaded ferrous.

Construction Documents

2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with North Carolina Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install fittings for changes in direction and branch connections.

3.2 INDOOR PIPING INSTALLATION

- A. Comply with North Carolina Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

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Construction Documents

- L. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- M. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- O. Connect branch piping from top or side of horizontal piping.
- P. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- Q. Do not use natural-gas piping as grounding electrode.
- R. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.

Construction Documents

- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameter, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameter, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.



Construction Documents

- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to North Carolina Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

3.9 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground, branch piping NPS 2 and smaller shall be the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- C. Valves in branch piping for single appliance shall be the following:

Construction Documents

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

Construction Documents

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Valves and specialties.
  - 3. Refrigerants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.

Construction Documents

- B. Wrought-Copper Fittings, Solder-Joint: ASME B16.22.
- C. Wrought-Copper Fittings, Brazed-Joint: ASME B16.50.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 4. Working Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.
- G. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Conex Banninger - USA.
    - b. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
  - 3. Housing: Copper.
  - 4. O-Rings: HNBR or compatible with specific refrigerant.
  - 5. Tools: Manufacturer's approved special tools.
  - 6. Minimum Rated Pressure: 700 psig

2.3 VALVES AND SPECIALTIES

- A. Check Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker Hannifin Corp.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.

Construction Documents

3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

B. Refrigerant Locking Caps:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. C & D Valve, LLC.
  - b. JB Industries.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant charging ports from unauthorized refrigerant access and leakage.
3. Material: Brass, with protective shroud or sleeve.
4. Refrigerant Identification: Color-coded, refrigerant specific design.
5. Special Tool: For installing and unlocking.

C. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. Danfoss Inc.
  - b. Heldon Products; Henry Technologies.
  - c. Parker Hannifin Corp.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
7. Working Pressure Rating: 400 psig.
8. Maximum Operating Temperature: 240 deg F.

D. Thermostatic Expansion Valves: Comply with AHRI 750.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

Construction Documents

- a. Danfoss Inc.
  - b. Emerson Climate Technologies.
  - c. Heldon Products; Henry Technologies.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
  3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Packing and Gaskets: Non-asbestos.
  5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  6. Suction Temperature: Confirm with HVAC manufacturer's recommendations.
  7. Reverse-flow option (for heat-pump applications).
  8. End Connections: Socket, flare, or threaded union.
  9. Working Pressure Rating: 450 psig.
- E. Straight-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Body: Welded steel with corrosion-resistant coating.
  3. Screen: 100-mesh stainless steel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig.
  6. Maximum Operating Temperature: 275 deg F.
- F. Angle-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Body: Forged brass or cast bronze.
  3. Drain Plug: Brass hex plug.
  4. Screen: 100-mesh monel.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg F.
- G. Moisture/Liquid Indicators:

Construction Documents

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Body: Forged brass.
  3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  4. Indicator: Color coded to show moisture content in parts per million (ppm).
  5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  6. End Connections: Socket or flare.
  7. Working Pressure Rating: 500 psig.
  8. Maximum Operating Temperature: 240 deg F.
- H. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
  3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  4. Desiccant Media: Activated alumina.
  5. Designed for reverse flow (for heat-pump applications).
  6. End Connections: Socket.
  7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
  8. Maximum Pressure Loss: 2 psig.
  9. Rated Flow: Coordinate with equipment ratings.
  10. Working Pressure Rating: 500 psig.
  11. Maximum Operating Temperature: 240 deg F.
- I. Permanent Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.

Construction Documents

- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- 2. Body and Cover: Painted-steel shell.
- 3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
- 4. Desiccant Media: Activated alumina.
- 5. Designed for reverse flow (for heat-pump applications).
- 6. End Connections: Socket.
- 7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
- 8. Maximum Pressure Loss: 2 psig.
- 9. Rated Flow: Coordinate with equipment ratings.
- 10. Working Pressure Rating: 500 psig.
- 11. Maximum Operating Temperature: 240 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. Arkema Inc.
  - b. DuPont Fluorochemicals Div.
  - c. Genetron Refrigerants; Honeywell International Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
  - 1. Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.



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Construction Documents

- C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- D. Install a full-size, three-valve bypass around filter dryers.
- E. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- G. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Hot-gas bypass valves.
  - 4. Compressor.
- H. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- I. Install receivers sized to accommodate pump-down charge as required by MFG.
- J. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to the authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

**Construction Documents**

- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

Construction Documents

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Comply with ASME B31.5, Chapter VI.

Construction Documents

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
  - a. Fill system with nitrogen to the required test pressure.
  - b. System shall maintain test pressure at the manifold gage throughout duration of test.
  - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
  - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

Construction Documents

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 ACTION SUBMITTALS

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

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

Construction Documents

- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and North Carolina Mechanical Code
- C. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 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.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with 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."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with 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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 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."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts installed serving chemical storage and pool equipment room, construct of Type 316 stainless steel indicated by manufacturer to be suitable for corrosive airflow.

Construction Documents

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. McGill AirFlow LLC.
  - b. Sheet Metal Connectors, Inc.
  - c. Spiral Manufacturing Co., Inc.
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate in accordance with 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."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate in accordance with 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.

E. Tees and Laterals: Select types and fabricate in accordance with 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."

2.4 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 A653/A653M.

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

C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

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- D. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.
- G. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. CertainTeed Insulation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 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. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. Ductmate Industries, Inc.
    - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.



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2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- C. Fiberglass-Free Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work:
    - a. Acoustical Surfaces, Inc.
    - b. Bonded Logic, Inc.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Maximum Thermal Conductivity: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
  3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
  4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- D. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 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.
- E. 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.

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6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
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. 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.

2.6 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 in accordance with 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.
- 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.

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8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
  
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-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 A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:

Construction Documents

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. 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.
- J. Install radiation dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.

## Construction Documents

- M. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.

### 3.2 DUCT SEALING

- A. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 3. Unconditioned Space, Exhaust Ducts (Negative Pressure): Seal Class C.
  - 4. Unconditioned Space, Exhaust Ducts (Positive Pressure): Seal Class A.
  - 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 7. Conditioned Space, Exhaust Ducts (Negative Pressure): Seal Class B.
  - 8. Conditioned Space, Exhaust Ducts (Positive Pressure): Seal Class A.
  - 9. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.3 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.
- 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.

## Construction Documents

- 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.

### 3.4 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.

### 3.5 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- C. Duct system will be considered defective if it does not pass tests and inspections.

### 3.7 STARTUP

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

### 3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Supply Ducts:

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1. Ducts Connected to Constant-Volume Air-Handling Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. SMACNA Leakage Class for Rectangular: 8.
  - c. SMACNA Leakage Class for Round and Flat Oval: 4.
  
- C. Return Ducts:
  1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. SMACNA Leakage Class for Rectangular: 8.
    - c. SMACNA Leakage Class for Round and Flat Oval: 4.
  
- D. Exhaust Ducts:
  1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. SMACNA Leakage Class for Rectangular: 4 for positive pressure, 8 for negative pressure.
    - c. SMACNA Leakage Class for Round and Flat Oval: 2 for positive pressure, 4 for negative pressure.
  
  2. Ducts Connected to Fans Exhausting Chemical & Pool Equipment Room Exhaust:
    - a. Type 316, stainless-steel sheet.
      - 1) Concealed: No. 2B finish.
    - b. Pressure Class: Positive or negative 2-inch wg.
    - c. Minimum SMACNA Seal Class A.
    - d. SMACNA Leakage Class 2.
  
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 4.
  
- F. Intermediate Reinforcement:
  1. Galvanized-Steel Ducts: Galvanized steel.
  2. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
  
  3. Aluminum Ducts: Aluminum.

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G. Liner:

1. Supply-Air Ducts: Fibrous glass, Type I, 2 inches thick.
2. Return-Air Ducts: Fibrous glass, Type I, 2 inches thick.
3. Supply Fan Plenums: Fibrous glass, Type II, 2 inches thick.
4. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 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. 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."
2. 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) 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.

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: Conical 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



Construction Documents

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Duct access panel assemblies.
8. Flexible connectors.
9. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

- 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.

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2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
    - a. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Description: Gravity balanced.
- C. Performance:
  - 1. Maximum Air Velocity: 2000 fpm.
  - 2. Maximum System Pressure: 2 inches wg.
  - 3. Leakage:
    - a. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.
- D. Construction:
  - 1. Frame:
    - a. Hat shaped.
    - b. 0.093-inch-thick extruded aluminum, with welded or mechanically attached corners and mounting flange.
  - 2. Blades:
    - a. Multiple single-piece blades.
    - b. Off-center or End pivoted, maximum 6-inch width, -0.050-inch-thick aluminum sheet with sealed edges.
  - 3. Blade Action: Parallel.
- E. Tie Bars and Brackets: Galvanized steel.
- F. Return Spring: Adjustable tension.
- G. Bearings: Steel ball or synthetic pivot bushings.
- H. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Chain pulls.
  - 4. Screen Mounting:

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- a. Rear mounted in sleeve.
  - 1) Sleeve Thickness: 20 gauge minimum.
  - 2) Sleeve Length: 6 inches minimum.
5. Screen Material: Aluminum.
6. Screen Type: Insect.
7. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. [Greenheck Fan Corporation](#).
  - b. [Nailor Industries Inc.](#)
  - c. [Ruskin Company](#).
  - d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Performance:
  - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Construction:
  - a. Linkage out of airstream.
  - b. Suitable for horizontal or vertical airflow applications.
4. Frames:
  - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel-
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized steel; 16 gauge thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
  - a. Molded synthetic or Stainless steel sleeve.

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- b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
- 8. Tie Bars and Brackets: Galvanized steel.
- 9. Locking device to hold damper blades in a fixed position without vibration.
- B. Jackshaft:
  - 1. Size: 1-inch diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

2.4 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc.
  - 3. DynAir; a Carlisle Company.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vaness and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- E. Vane Construction:
  - 1. Single wall.

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2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Greenheck Fan Corporation.
  - 2. Pottorff.
  - 3. Ruskin Company.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Type: Static and dynamic; rated and labeled in accordance with UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Varies, as indicated on engineering drawings; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed galvanized sheet steel. Material gauge is to be in accordance with UL listing.
- I. Horizontal Dampers: Include blade lock and stainless steel closure spring.
- J. Heat-Responsive Device:
  - 1. Replaceable, 165 deg F rated, fusible links.

2.6 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Aire Technologies.
  - 2. Flexmaster U.S.A., Inc.
  - 3. Ruskin Company.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
  - 1. Door:

Construction Documents

- a. Double wall, rectangular.
  - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
  - c. 24-gauge-thick galvanized steel or 0.032-inch thick aluminum or 24-gauge-thick stainless steel door panel.
  - d. Vision panel.
  - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
  - f. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
    - a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
    - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.7 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  1. CL WARD & Family Inc.
  2. Ductmate Industries, Inc.
  3. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Access panels used in cooking applications:
  1. Labeled compliant to NFPA 96 for grease duct access doors.
  2. Labeled in accordance with UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 16-gauge carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10 inches wg positive or negative.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

Construction Documents

1. [CL WARD & Family Inc.](#)
  2. [Ductmate Industries, Inc.](#)
  3. [DynAir; a Carlisle Company.](#)
  4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. 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.
- G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
  2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
  3. Service Temperature: Minus 67 to plus 500 deg F.
- 2.9 DUCT ACCESSORY HARDWARE
- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
1. [CL WARD & Family Inc.](#)
  2. [Ductmate Industries, Inc.](#)
  3. [Duro Dyne Inc.](#)
  4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

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Construction Documents

2.10 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- F. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. 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.
  - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.



**Construction Documents**

- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install radiation dampers in accordance with UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to radiation dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. Control devices requiring inspection.
  - 8. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

**3.2 FIELD QUALITY CONTROL**

- A. Tests and Inspections:

Construction Documents

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate radiation dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

Construction Documents

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Non-insulated flexible ducts.
  - 2. Insulated flexible ducts.

1.2 ACTION SUBMITTALS

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

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 NON-INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Thermaflex; a Flex-Tek Group company.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Non-Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F.

Construction Documents

2.3 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Thermaflex; a Flex-Tek Group company.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F.
  - 4. Insulation R-Value: Comply with NCECC.

2.4 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
  
- B. Non-Clamp Connectors: Adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
  
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
  
- C. Connect diffusers or light troffer boots to ducts directly with maximum lengths (as specified in General Notes on plans) of flexible duct clamped or strapped in place.
  
- D. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
  
- E. Install duct test holes where required for testing and balancing purposes.
  
- F. Installation:
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.

Construction Documents

4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346



Construction Documents

SECTION 233423 - HVAC POWER VENTILATORS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Ceiling-mounted ventilators.
  - 2. Centrifugal ventilators - roof downblast.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

Construction Documents

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Broan-NuTone LLC.
  - 2. Greenheck Fan Corporation.
  - 3. PennBarry.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.
- D. Back-draft damper: Integral.
- E. Grille: Louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories: See Engineering Drawings Schedule

2.2 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Greenheck Fan Corporation.
  - 2. Loren Cook Company.
  - 3. PennBarry.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Housing: Downblast; spun aluminum; square, one-piece aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Accessories: See Engineering Drawings Schedule
- E. Prefabricated 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.



Construction Documents

2.3 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. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.
- E. Operating Limits: Classify according to AMCA 99.
- F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- D. See engineering drawings for notes pertaining to fan installation in high wind zone.
- E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

Construction Documents

- F. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 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.

Construction Documents

3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. 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.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

- C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423



Construction Documents

SECTION 233433.13 - COMMERCIAL AIR CURTAINS

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes commercial air-curtain unit.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period (Nonheating Units): 60 months.

Construction Documents

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Capacities and Characteristics:

1. Application: Fly and insect control.
2. Mounting Type: Wall brackets.
3. Discharge Direction: Vertical.
4. Door Type: Exterior.
5. Unit Length: See Engineering Drawing Schedules.
6. Airflow: See Engineering Drawing Schedules.
7. Intake: Internal.
8. Fan Motor:
  - a. Electrical Characteristics:
    - 1) Horsepower: See Engineering Drawing Schedules.
    - 2) Volts: 120 V.
    - 3) Phase: Single.
    - 4) Hertz: 60 Hz.

2.2 COMMERCIAL AIR-CURTAIN UNIT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Fantech.
2. Loren Cook Company.
3. Mars Air Doors; Mars Air Systems.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Housing:

1. Galvanized Steel: Galvanized steel with electrostatically applied, epoxy-enamel, powder-coat finish.
2. Discharge Nozzle: Integral to housing, containing adjustable air-directional vanes with 40-degree sweep front to back.

C. Mounting Brackets: Galvanized steel, for wall mounting.

D. Air-Intake Grilles:

1. Grilles: Integral to, and same material as, housing.

E. Fans:

1. Centrifugal, forward curved, double width, double inlet.

Construction Documents

2. Galvanized steel.
3. Statically and dynamically balanced.
4. Direct drive.

F. Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Single speed.
3. Resiliently mounted.
4. Continuous duty.
5. Totally enclosed, air over.
6. Integral thermal-overload protection.
7. Bearings: Permanently sealed, lifetime, prelubricated, ball bearings.
8. Disconnect: Lockable disconnect.

G. Filters:

1. Washable Panel Filters: Removable, aluminum, baffle-type filters with spring-loaded fastening; with minimum 0.0781-inch-thick, stainless steel filter frame.
2. Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

H. Controls:

1. Automatic Door Switch: Type as required, installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.

I. Accessories:

1. Mounting Brackets: Adjustable mounting brackets for wall mounting.
2. Discharge Extension Neck: For ceiling-recessed installation.

## 2.3 SOURCE QUALITY CONTROL

- A. Comply with AHRI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils," for components, construction, and rating.
- B. Comply with NSF 37, "Air Curtains for Entrances in Food and Food Service Establishments."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install air curtains with clearance for equipment service and maintenance.
- B. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.2 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.3 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing air curtains completely, perform visual and mechanical check of individual components.
  - 2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation. Certify compliance with test parameters.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.



Construction Documents

- C. Air-curtain unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust motor speed to achieve specified airflow.
- B. Adjust discharge louver and dampers to regulate airflow.
- C. Adjust air-directional vanes.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial air curtains.

END OF SECTION 233433.13



Construction Documents

SECTION 233600 - AIR TERMINAL UNITS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bypass, single-duct air terminal units.
2. Modulating, single-duct air terminal units.
3. Parallel, fan-powered air terminal units.
4. Series, fan-powered air terminal units.
5. Casing liner.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

Construction Documents

2.2 BYPASS, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Carrier Corporation.
  - 2. Titus, a division of Air System Components; Johnson Controls, Inc.
  - 3. Trane.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Configuration: Diverting-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.040-inch- thick galvanized steel, single wall.
- D. Electric Controls: Damper actuator and communicating bypass controller.
  - 1. Damper Actuator: 24 V, powered closed, powered open.
  - 2. Communicating bypass controller: Integral UCM board, static pressure sensor and discharge air temperature sensor.

2.3 MODULATING, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Carrier Corporation.
  - 2. Titus, a division of Air System Components; Johnson Controls, Inc.
  - 3. Trane.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.040-inch- thick galvanized steel, single wall.
  - 1. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 2. Air Outlet: S-slip and drive connections.
  - 3. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
- E. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
  - 1. Electronic Damper Actuator: 24 V, powered open, capacitous return.
  - 2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  - 3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5

Construction Documents

percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.

4. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
  - a. Occupied and unoccupied operating mode.
  - b. Remote reset of airflow or temperature set points.
  - c. Adjusting and monitoring with portable terminal.
  - d. Communication with temperature-control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
5. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

F. Controls:

1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
2. System-powered, wall-mounted thermostat.

G. Control Sequences:

1. Occupied:
  - a. On a call for cooling (or heating, if in changeover), airflow will increase as the damper opens towards maximum setting to satisfy set point.
  - b. On a call for less cooling (or heating, if in changeover), airflow will decrease as the damper closes towards minimum setting to satisfy set point.
2. Unoccupied:
  - a. Damper closes to minimum setting.

2.4 PARALLEL FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  1. Carrier Corporation.
  2. Titus, a division of Air System Components; Johnson Controls, Inc.
  3. Trane.
- B. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.031-inch- thick galvanized steel, single wall.

Construction Documents

1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
  2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
  5. Fan: Forward-curved centrifugal, located at plenum air inlet.
- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
- E. Velocity Sensors: Multipoint array with velocity sensors.
- F. Motor:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  2. Type: Permanent-split capacitor with SCR for speed adjustment.
  3. Fan-Motor Assembly Isolation: Rubber isolators.
  4. Enclosure: Open dripproof .
  5. Motor Speed: Multispeed.
    - a. Speed Control: Infinitely adjustable with electronic controls.
- G. Filters:
1. 1" thickness, per MFG.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware. Provide electric-resistance heating coils for air terminal units scheduled on Drawings.
1. Location: Plenum air inlet.
  2. Stage(s): As Indicated on Engineering Drawings
  3. Access door interlocked disconnect switch.
  4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  5. Nickel chrome 80/20 heating elements.
  6. Airflow switch for proof of airflow.
  7. Fan interlock contacts.
  8. Fuses in terminal box for overcurrent protection (for coils more than 30 A).
  9. Magnetic contactors.
- I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.

Construction Documents

1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
  2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
  3. Disconnect Switch: Factory-mounted, fuse type.
- J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- K. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
1. Electronic Damper Actuator: 24 V, powered open, capacitous return.
  2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
  4. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
- L. Control Sequence: See Engineering Drawings.

2.5 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
1. [Carrier Corporation.](#)
  2. [Titus, a division of Air System Components; Johnson Controls, Inc.](#)
  3. [Trane.](#)
  4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.
- C. Casing: 0.031-inch- thick galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass duct liner.
  2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
  5. Fan: Forward-curved centrifugal.

Construction Documents

- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
- E. Velocity Sensors: Multipoint array with velocity sensors in air inlets and air outlets.
- F. Motor:
  - 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Type: Permanent-split capacitor with SCR for speed adjustment.
  - 3. Fan-Motor Assembly Isolation: Rubber isolators.
  - 4. Enclosure: Open dripproof.
  - 5. Motor Speed: Multispeed.
    - a. Speed Control: Infinitely adjustable with electronic controls.
- G. Filters: 1" thickness, per MFG.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware. Provide electric-resistance heating coils for air terminal units scheduled on Drawings.
  - 1. Stage(s): See Engineering Drawings Schedule.
  - 2. Access door interlocked disconnect switch.
  - 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  - 4. Nickel chrome 80/20 heating elements.
  - 5. Airflow switch for proof of airflow.
  - 6. Fan interlock contacts.
  - 7. Fuses in terminal box for overcurrent protection (for coils more than 30 A).
  - 8. Magnetic contactors.
- I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
  - 1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
  - 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
  - 3. Disconnect Switch: Factory-mounted, fuse type.
- J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.



## Construction Documents

- K. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
  - 1. Electronic Damper Actuator: 24 V, powered open, capacitous return.
  - 2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  - 3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
  - 4. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
  
- L. Control Sequence: See Engineering Drawings.

### 2.6 CASING LINER

- A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Minimum Thickness: 1 inch.
    - a. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

### 2.7 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
  - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

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Construction Documents

- B. Hangers Exposed to View: Threaded rod and angle or channel supports.
- C. 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.

3.2 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.
- D. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- E. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- F. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."
- G. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Air terminal unit will be considered defective if it does not pass tests and inspections.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

Construction Documents

SECTION 233713.13 - AIR DIFFUSERS

**TIPS:**

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**Content Requests:**

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Linear bar diffusers.
4. Linear slot diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Hart & Cooley Inc.

Construction Documents

2. Price Industries.
3. Titus, a division of Air System Components; Johnson Controls, Inc.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 PERFORATED DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Hart & Cooley Inc.
2. Price Industries.
3. Titus, a division of Air System Components; Johnson Controls, Inc.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.3 LINEAR BAR DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Hart & Cooley Inc.
2. Price Industries.
3. Titus, a division of Air System Components; Johnson Controls, Inc.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.4 LINEAR SLOT DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Hart & Cooley Inc.
2. Price Industries.
3. Titus, a division of Air System Components; Johnson Controls, Inc.
4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers 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,

Construction Documents

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 with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

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

END OF SECTION 233713.13



Construction Documents

SECTION 233713.23 - REGISTERS AND GRILLES

**TIPS:**

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**Content Requests:**

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adjustable blade face registers and grilles.
2. Fixed face registers and grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Adjustable Blade Face Register:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - a. Hart & Cooley Inc.

Construction Documents

- b. Price Industries.
- c. Titus, a division of Air System Components; Johnson Controls, Inc.
- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Fixed Face Register:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

- a. Hart & Cooley Inc.
- b. Price Industries.
- c. Titus, a division of Air System Components; Johnson Controls, Inc.
- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 GRILLES

A. Adjustable Blade Face Grille:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

- a. Hart & Cooley Inc.
- b. Price Industries.
- c. Titus, a division of Air System Components; Johnson Controls, Inc.
- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Fixed Face Grille:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

- a. Hart & Cooley Inc.
- b. Price Industries.
- c. Titus, a division of Air System Components; Johnson Controls, Inc.
- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install registers and grilles level and plumb.



Construction Documents

- B. Outlets and Inlets Locations: 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 registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

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

END OF SECTION 233713.23



Construction Documents

SECTION 233723 - HVAC GRAVITY VENTILATORS

**TIPS:**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Hooded ventilators.

1.2 ACTION SUBMITTALS

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

1.3 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on Structural Drawings.

Construction Documents

- B. Capacities and Characteristics: See Engineering Drawings Schedule

2.2 FABRICATION

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 HOODED VENTILATORS

- A. Description: Hooded round penthouse for intake air.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Greenheck Fan Corporation.
  - 2. Loren Cook Company.
  - 3. PennBarry.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- C. Construction:
  - 1. Material: Aluminum, of thickness required to comply with structural performance requirements, but not less than 0.063-inch-thick base and 0.050-inch-thick hood; suitably reinforced.
  - 2. Insulation: None.
  - 3. Bird Screening: Aluminum, 1/2-inch-square mesh or flattened, expanded aluminum, 3/4-inch diamond mesh wire.
  - 4. Insect Screening: Aluminum, 18-by-16 mesh wire.
- D. Galvanized-Steel Finish:
  - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas, and repair galvanizing according to ASTM A780/A780M. Apply a conversion coating suited to the organic coating to be applied over it.
  - 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.

Construction Documents

3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
  - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- E. Roof Curbs: Galvanized-steel sheet; with 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 fit roof opening and ventilator base.
  1. Overall Height: 12 inches.

2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  1. Use types and sizes to suit unit installation conditions.
  2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with zinc-plated hardware, that comply with the wind fastening requirements. Use concealed anchorages where possible. Refer to Section 077200 "Roof Accessories."
- C. Install gravity ventilators with clearances for service and maintenance.

Construction Documents

- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- I. Refer to Section 077200 "Roof Accessories" for flashing and counterflashing of roof curbs.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

END OF SECTION 233723

Construction Documents

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

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**Content Requests:**

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PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Commercial-kitchen hoods, Type I.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Filters/baffles.
2. Fire-suppression systems.
3. Luminaires.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 HOOD MATERIALS

A. Stainless-Steel Sheet: Type 430

1. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.

Construction Documents

- a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
  2. Concealed Stainless-Steel Surfaces: ASTM A480/A480M, No. 2B finish (bright, cold-rolled, unpolished finish).
  3. Exposed Surfaces: ASTM A480/A480M, No. 3 finish (intermediate polished surface) or ASTM A480/A480M, No. 4 finish (directional satin).
  4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Zinc-Coated Steel Shapes: ASTM A36/A36M, zinc coated according to ASTM A123/A123M requirements.
- C. Sealant: ASTM C920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.
1. Color: As selected by Architect from manufacturer's full range.
  2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- D. Sound Dampening: NSF-certified, non-absorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch thickness that does not chip, flake, or blister.
- E. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.3 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
  2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
  3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
  4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
  5. After zinc-coated steel is welded, clean welds and abraded areas and apply SSPC-Paint 20, high-zinc-dust-content, galvanizing repair paint to comply with ASTM A780/A780M.
- B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."



Construction Documents

- C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.
- D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- F. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- G. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- H. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- I. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets unless otherwise indicated.
- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- K. Fabricate enclosure panels to ceiling and wall as follows:
  - 1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
  - 2. Wall Offset Spacer: Minimum of 3 inches.
  - 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch-thick, stainless-steel shelf tops.

2.4 EXHAUST HOOD FABRICATION, TYPE I HOOD

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Captive-Aire Systems.
  - 2. Greenheck Fan Corporation.
  - 3. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
  - 1. Fabricate hoods according to NSF 2, "Food Equipment."
  - 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.

Construction Documents

3. Duct Collars: Minimum 0.0598-inch-thick steel at least 3 inches long, continuously welded to top of hood and at corners.
- C. Hood Configuration: Exhaust and makeup air.
  1. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
- D. Hood Style: Wall-mounted canopy.
- E. Filters/Baffles: Removable, stainless-steel, with spring-loaded fastening. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Safety for Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- F. Luminaires: Surface-mounted, LED fixtures and lamps with lenses sealed vapor tight. Wiring shall be in conduit on hood exterior. Number and location of luminaires shall provide a minimum of 70 fc at 30 inches above finished floor.
  1. Light switches shall be mounted on front panel of hood canopy.
  2. Luminaires: Complying with UL 1598.
- G. Hood Controls: Hood-mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.
  1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation.
  2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
  3. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.
- H. Capacities and Characteristics: See Hood Drawings.

2.5 FIRE-SUPPRESSION SYSTEM, WET CHEMICAL

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  1. Ansul by Johnson Controls Company.
  2. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be

Construction Documents

listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.

1. Steel Pipe, NPS 2 and Smaller: ASTM A53/A53M, Type S, Grade A, Schedule 40, plain ends.
2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
5. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
6. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
7. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Coordinate equipment layout and installation with adjacent Work, including luminaires, HVAC equipment, plumbing, and fire-suppression system components.
- B. Complete field assembly of hoods where required.
  1. Make closed butt and contact joints that do not require filler.
  2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in "General Hood Fabrication Requirements" Article.
- C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- D. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- E. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.
- F. Install hoods to operate free from vibration.

Construction Documents

- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.
- K. Set field-adjustable switches.
- L. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- M. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Perform hood performance tests required by authorities having jurisdiction.
  - 4. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- B. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.

END OF SECTION 233813

Construction Documents

SECTION 235123 - GAS VENTS

**TIPS:**

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**Content Requests:**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Listed double-wall vents.
- B. Related Requirements:

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Hart & Cooley Inc.
  - 2. M&G DuraVent, Inc.; a member of the M&G Group.
  - 3. Metal-Fab, Inc.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

Construction Documents

- D. Inner Shell: ASTM B209, Type 3003 aluminum.
- E. Outer Jacket: Galvanized steel.
- F. Accessories: Tees, elbows, increasers, draft-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.
  - 1. Termination: Coordinate w/ Unit Heater MFG.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Listed Type B and BW Vents: Vents for certified gas appliances.

3.2 INSTALLATION OF LISTED VENTS

- A. 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 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. Lap joints in direction of flow.
- E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

Construction Documents

SECTION 235533.16 - GAS-FIRED UNIT HEATERS

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gas-fired unit heaters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of gas-fired unit heater.
  - 1. Include rated capacities, operating characteristics, and accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One years from date of Substantial Completion.

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Construction Documents

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:

1. Lennox Industries, Inc.; Lennox International.
2. REZNOR, a brand of Nortek Global HVAC.
3. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 PERFORMANCE REQUIREMENTS

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

2.3 MANUFACTURED UNITS

- A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- C. Type of Venting: Gravity vented.
- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
  1. Discharge Louvers: Independently adjustable, horizontal blades.
- E. Accessories:
  1. Four-point suspension kit.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Propeller Unit Fan:
  1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
  2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
- I. Centrifugal Unit Fan:
  1. Steel, centrifugal fan dynamically balanced and resiliently mounted.
  2. Belt-Driven Drive Assembly:



Construction Documents

- a. 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.
  
- J. Motors:
  - 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  
- K. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
  - 1. Gas Control Valve: Single stage.
  - 2. Ignition: Electronically controlled electric spark with flame sensor.
  - 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  - 4. Vent Flow Verification: Differential pressure switch to verify open vent.
  - 5. Control transformer.
  - 6. High Limit: Thermal switch or fuse to stop burner.
  - 7. Thermostat: Devices and wiring are specified in Section 230923.27 "Temperature Instruments."
  - 8. Wall-Mounted Thermostat:
    - a. Single stage.
    - b. Fan on-off-automatic switch.
    - c. 24-V ac.
    - d. 50 to 90 deg F operating range.
  
- L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written instructions.

3.2 EQUIPMENT MOUNTING

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- B. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.

Construction Documents

1. Spring hangers are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
2. Threaded Rods, Spring Hangers, and Building Attachments: Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" and Section 230548 "Vibration and Seismic Controls for HVAC."
3. Anchor the unit to resist code-required horizontal acceleration.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.
- C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- D. Vent Connections: Comply with Section 235123 "Gas Vents."
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

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 the following tests and inspections:
  1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  2. Verify bearing lubrication.
  3. Verify proper motor rotation.
  4. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.

Construction Documents

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.

END OF SECTION 235533.16



Construction Documents

SECTION 237313.13 - INDOOR, BASIC AIR-HANDLING UNITS

**TIPS:**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes factory-assembled, indoor air-handling units with limited features, including the following components and accessories:
  - 1. Casings.
  - 2. Fans, drives, and motors.
  - 3. Coils.

1.2 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.4 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of indoor, basic, air-handling units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Manufacturer's standard, but not less than one year(s) from date of Substantial Completion.

Construction Documents

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

2.2 CAPACITIES AND CHARACTERISTICS

- A. See Engineering Drawing Schedules, MF-1, for more information.

2.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Carrier Corporation.
  - 2. Trane.
  - 3. Greenheck
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.4 UNIT CASINGS

- A. General Fabrication Requirements for Casings;
  - 1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
  - 2. Joints: Sheet metal screws or pop rivets.
  - 3. Sealing: Seal all joints with water-resistant sealant. Hermetically seal at each corner and around entire perimeter.
  - 4. Base Rail:
    - a. Material: Galvanized steel.
    - b. Height: 4 inches.
- B. Double-Wall Construction:
  - 1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick, with manufacturer's standard finish.
  - 2. Inside Casing Wall: G90 galvanized steel, solid, minimum 18 gauge thick.
  - 3. Floor Plate: G90 galvanized steel, minimum 18 gauge thick.
  - 4. Casing Insulation:

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Construction Documents

- a. Materials: Glass-fiber blanket or board insulation, Type I or Type II ASTM C1071 or injected polyurethane foam insulation.
- b. Insulation Thickness: 1 inch.
- c. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

C. Static-Pressure Classifications:

- 1. For Unit Sections Upstream of Fans: Minus 2-inch wg.
- 2. For Unit Sections Downstream and Including Fans: 2-inch wg.

D. Panels and Doors:

1. Panels:

- a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
- b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.
- c. Gasket: Neoprene, applied around entire perimeters of panel frames.
- d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components.

2. Locations and Applications:

- a. Fan Section: Panels.
- b. Coil Section: Panels.
- c. Access Section: Panels.
- d. Access Sections Immediately Upstream and Downstream of Coil Sections: Panels.

2.5 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Fans: Centrifugal, rated according to AMCA 210; galvanized steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

- a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

- a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

Construction Documents

- a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
  5. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel hub swaged to backplate and fastened to shaft with setscrews.
  6. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
  7. Shaft Lubrication Lines: Extended to a location outside the casing.
  8. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.
    - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
  - C. Drive, Direct: Factory-mounted, direct drive.
  - D. Drive, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
    1. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
    2. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
    3. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch-thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
  - E. Motors:
    1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
    3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
- 2.6 COIL SECTION
- A. General Requirements for Coil Section:
    1. Comply with AHRI 410.
    2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).



Construction Documents

3. Coils shall not act as structural component of unit.

B. Heating Coils:

1. Electrical Coils: Comply with UL 1995.
  - a. Casing Assembly: Slip-in type with galvanized-steel frame.
  - b. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
  - c. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
  - d. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
  - e. Control Panel: Unit mounted with disconnecting means and overcurrent protection.
    - 1) Magnetic contactor.
    - 2) Solid-state, stepless pulse controller.
    - 3) Toggle switches, one per step.
    - 4) Step controller.
    - 5) Time-delay relay.
    - 6) Pilot lights, one per step.
    - 7) Airflow proving switch.

2.7 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.8 SOURCE QUALITY CONTROL

- A. AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- B. Equipment Mounting:
  - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers. Coordinate sizes and locations of structural-steel support members with actual equipment provided. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.2 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.3 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

Construction Documents

- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- B. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313.13



Construction Documents

SECTION 237416.11 - PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components:
1. Casings.
  2. Fans, drives, and motors.
  3. Coils.
  4. Refrigerant circuit components.
  5. Air filtration.
  6. Gas furnaces.
  7. Dampers.
  8. Electrical power connections.
  9. Controls.
  10. Roof curbs.
  11. Accessories.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

Construction Documents

1.4 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: (1) year(s) from date of Substantial Completion.
  - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. UL Compliance: Comply with UL 1995.
- B. Wind-Restraint Performance: Unit (& Curb) are installed in a high wind zone and must be permitted to be installed in a 130 MPH wind zone.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. Carrier Corporation.
  - 2. Trane.
  - 3. YORK; a Johnson Controls company.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Wall Construction:
  - 1. Outside Casing Wall: Galvanized steel, with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - 2. Casing Insulation:
    - a. Materials: Injected polyurethane foam insulation or fiberglass insulation.
    - b. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.
- C. Panels and Doors:

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Construction Documents

1. Panels:
  - a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
  - b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
  - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
  - d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
  
2. Locations and Applications:
  - a. Fan Section: Inspection and access panels.
  - b. Coil Section: Inspection and access panels.
  - c. Damper Section: Inspection and access panels.
  - d. Filter Section: Inspection and access panels large enough to allow periodic removal and installation of filters.

D. Condensate Drain Pans:

1. Location: Each type of cooling coil-
2. Construction:
  - a. Single-wall, non-corrosive.
  
3. Drain Connection:
  - a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on end of pan.
  - b. Minimum Connection Size: NPS 1.
  
4. Slope: Minimum 0.125-in./ft. slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
5. Width: Entire width of water producing device..
6. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
7. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
  
- B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.
  1. Shafts: With field-adjustable alignment.

Construction Documents

- a. Turned, ground, and polished hot-rolled steel with keyway.
  2. Shaft Bearings:
    - a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.
  3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
    - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
  5. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
  6. Shaft Lubrication Lines: Extended to a location outside the casing.
- C. Drives, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
1. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
  2. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
  3. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
- D. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motors.
- E. Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  3. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
  4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.5 COILS

- A. General Requirements for Coils:



Construction Documents

1. Comply with AHRI 410.
2. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Supply-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.

C. Outdoor-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.

D. Hot-Gas Reheat Refrigerant Coil:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.
6. Suction-discharge bypass valve.

Construction Documents

2.6 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Hermetic scroll, with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
  
- B. Refrigeration Specialties:
  - 1. Refrigerant: R-410A.
  - 2. Expansion valve with replaceable thermostatic element.
  - 3. Refrigerant filter/dryer.
  - 4. Manual-reset high-pressure safety switch.
  - 5. Automatic-reset low-pressure safety switch.
  - 6. Minimum off-time relay.
  - 7. Automatic-reset compressor motor thermal overload.
  - 8. Brass service valves installed in compressor suction and liquid lines.
  - 9. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.7 AIR FILTRATION

- A. Panel Filters:
  - 1. Description: Factory-fabricated, self-supported, disposable air filters with holding frames.
  - 2. Filter Unit Class: UL 900.
  - 3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
  - 4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

2.8 GAS FURNACES

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
  
- B. CSA Approval: Designed and certified by and bearing label of CSA.
  
- C. Burners: Stainless steel.
  - 1. Fuel: Natural gas.
  - 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
  - 3. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.
  
- D. Heat-Exchanger and Drain Pan: Stainless steel.
  
- E. Venting, Power: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.
  
- F. Safety Controls:

Construction Documents

1. Gas Manifold: Safety switches and controls complying with ANSI standards.

2.9 DAMPERS

- A. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.
- B. Barometric relief dampers.

2.10 CONTROLS: See Engineering Drawings.

2.11 ROOF CURBS: See Engineering Drawings.

2.12 ACCESSORIES: See Engineering Drawings

2.13 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.14 SOURCE QUALITY CONTROL

A. AHRI Compliance:

1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.

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Construction Documents

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested according to AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- B. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

3.2 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to RTU, allow space for service and maintenance.
- C. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping."-Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

3.3 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
  1. Install ducts to termination at top of roof curb.
  2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
  4. Install return-air duct continuously through roof structure.

Construction Documents

3.4 ELECTRICAL CONNECTIONS

- A. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs as specified in Section 260553 "Identification for Electrical Systems."
  - 2. Locate nameplate where easily visible.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
  - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. RTU will be considered defective if it does not pass tests and inspections.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237416.11



Construction Documents

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

**Content Requests:**

[<Double click here to submit questions, comments, or suggested edits to this Section.>](#)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes factory-assembled, dedicated outdoor air-handling units, including multiple components, capable of heating and cooling 100 percent outdoor air.

1.2 ACTION SUBMITTALS

- A. Product Data: For each dedicated outdoor-air unit.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 WARRANTY

- A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Dedicated Outdoor-Air-Handling Units: One years from date of Substantial Completion.
  - 2. Warranty Period for Compressors: Five years from date of Substantial Completion.
  - 3. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.

Construction Documents

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an "NRTL" (nationally recognized testing laboratory), and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.
- C. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.
- A. Wind-Restraint Performance: Wind-Restraint Performance: Unit (& Curb) are installed in a high wind zone and must be permitted to be installed in a 130 MPH wind zone.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
  - 1. AAON.
  - 2. Munters Corporation.
  - 3. Captiveaire
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Source Limitations: Obtain dedicated outdoor-air units from single manufacturer.

2.3 UNIT CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Configuration: Horizontal unit with bottom discharge for roof-mounting installation.
- C. Double-Wall Configuration:
  - 1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with corrosion-resistant coating, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - 2. Inside Casing Wall:
    - a. Inside Casing, Burner Section: Galvanized steel, solid, minimum 14-gauge- thick steel.
    - b. Inside Casing, All Other Sections: Galvanized steel, solid.



Construction Documents

3. Floor Plate: Reinforced metal surface; reinforced to limit deflection when walked on by service personnel. Insulation is provided below metal walking surface.
4. Roof: Standing seam or membrane; sloped to drain water.
5. Casing Insulation:
  - a. Materials: Polyurethane foam insulation.
  - b. Casing Panel R-Value: Minimum R-13.
  - c. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

D. Panels and Doors:

1. Panels:

- a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
- b. Fasteners: Two or more camlock-type fasteners for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
- c. Gasket: Neoprene, applied around entire perimeters of panel frames.
- d. Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components

2. Doors:

- a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
- b. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
- c. Gasket: Neoprene, applied around entire perimeters of panel frames.
- d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components.

3. Locations and Applications:

- a. Fan Section: Doors.
- b. Access Section: Doors.
- c. Gas-Fired Burner Section: Panels.
- d. Damper Section: Doors.
- e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
- f. Relief Section: Doors.

E. Condensate Drain Pans:

1. Location: Each refrigerant coil.
2. Construction:
  - a. Single-wall, stainless steel sheet.

Construction Documents

3. Size: Large enough to collect condensate from cooling coils, including coil piping connections, coil headers, and return bends.
4. Drain Connection:
  - a. Located on both ends of pan, at lowest point of pan.
  - b. Terminated with threaded nipple.
  - c. Minimum Connection Size: NPS 1.
5. Slope: Minimum 0.125-inch/ft. slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
6. Length: Extend drain pan downstream from leaving face.
7. Width: Entire width of water-producing device.
8. Depth: A minimum of 2 inches deep.
9. Provide units having stacked coils with intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Supply-Air Fans and Relief-Air Fans: Centrifugal; galvanized or painted steel; mounted on solid-steel shaft.
  1. Shafts: With field-adjustable alignment.
    - a. Turned, ground, and polished hot-rolled steel with keyway.
  2. Shaft Bearings:
    - a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours in accordance with ABMA 9.
  3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
    - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
  5. Backward-Inclined, Centrifugal Fan Wheels: Construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
  6. Mounting: For internal vibration isolation. Factory mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
  7. Shaft Lubrication Lines: Extended to a location outside the casing.

Construction Documents

8. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.
  - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
- C. Drive, Direct: Factory-mounted direct drive.
- D. Drive, Belt: Factory-mounted V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
  1. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
  2. Belts: Oil resistant, nonsparking and nonstatic; in matched sets for multiple-belt drives.
  3. Belt Guards: Comply with requirements specified by OSHA and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards"; 0.146-inch- thick, 3/4-inch-diamond-mesh wire screen, welded to steel angle frame; prime coated.
- E. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated motors.
- F. Motors:
  1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  3. Motor Pulleys: Adjustable pitch for use with 5 hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
  4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  5. Mount unit-mounted disconnect switches on exterior of unit.
- G. Variable-Frequency Motor Controller: By MFG. Serving all fans in fan array.

2.5 COILS

- A. General Requirements for Coils:
  1. Comply with AHRI 410.
  2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
  3. Coils are not to act as structural component of unit.
- B. Supply-Air Refrigerant Coils:

Construction Documents

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: Corrosion-resistant coating.
7. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.

C. Hot-Gas Reheat Refrigerant Coils:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Coatings: Corrosion-resistant coating.
6. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.
7. Suction-discharge bypass valve.

D. Condenser Refrigerant coils:

1. Tube Material: Copper.
2. Fin Material: Aluminum.
3. Fin and Tube Joint: Mechanical bond.
4. Coating: Corrosion-resistant.

2.6 REFRIGERATION CIRCUIT COMPONENTS

- A. Compressors: Hermetic, variable-speed scroll compressors, mounted on integral vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.
- B. Refrigerant: R-410A.
- C. Refrigeration Specialties:
  1. Expansion valve with replaceable thermostatic element.
  2. Refrigerant filter/dryer.
  3. Manual-reset high-pressure safety switch.
  4. Automatic-reset low-pressure safety switch.
  5. Minimum off-time relay.

Construction Documents

6. Automatic-reset compressor motor thermal overload.
7. Thermostat for coil freeze-up protection during low-ambient-temperature operation or loss of air.
8. Brass service valves installed in discharge and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Modulating hot-gas reheat solenoid valve with a replaceable magnetic coil.

2.7 AIR FILTRATION

A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

B. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Cartridge filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.8 INDIRECT-FIRED GAS FURNACE HEATING

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47 and with NFPA 54.

B. CSA Approval: Designed and certified by and bearing label of CSA.

C. Burners:

1. Heat-Exchanger Material: Stainless steel.
2. Fuel: Natural gas.
3. Ignition: Electronically controlled electric spark with flame sensor.
4. Gas Control Valve: Electronic modulating.
5. Gas Train: Single-body, regulated, redundant, 24 V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

D. Venting, Gravity: Gravity vented.

E. Venting, Power: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.

Construction Documents

- F. Heat-Exchanger Drain Pan: Stainless steel.
- G. Safety Controls:
  - 1. Gas Manifold: Safety switches and controls complying with ANSI standards.
  - 2. Vent Flow Verification: Differential pressure switch to verify open vent OR Flame rollout switch.
  - 3. High Limit: Thermal switch or fuse to stop burner.
  - 4. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
  - 5. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
  - 6. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
  - 7. 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.

2.9 DAMPERS

- A. Outdoor- and Relief-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed or parallel-blade arrangement with steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1 inch wg and 8 cfm/sq. ft. at 4 inches wg.
- B. Electronic Damper Operators:
  - 1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 2. Electronic damper position indicator shall have visual scale indicating percentage of travel and 2 to 10 V dc feedback signal.
  - 3. Operator Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
    - c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  - 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  - 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
  - 6. Size dampers for running torque calculated as follows:

Construction Documents

- a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
  - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
  - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
  - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
  - e. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
  - f. Dampers with 3 to 4 Inches wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
7. Coupling: V-bolt and V-shaped, toothed cradle.
  8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  9. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
  10. Power Requirements (Two-Position Spring Return): 24 V dc.
  11. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
  12. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2 to 10 V dc position feedback signal.
  13. Temperature Rating: Minus 22 to plus 122 deg F.

2.10 ELECTRICAL POWER CONNECTIONS

- A. Single-Point Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.
- C. Wiring: Numbered and color-coded to match wiring diagram.
- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- E. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
  1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection in accordance with IEC 60947-4-1.
  2. NEMA KS 1, heavy-duty, nonfusible switch.
  3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- F. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- G. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- H. Controls: Factory wire unit-mounted controls where indicated.
- I. Control Relays: Auxiliary and adjustable time-delay relays.

Construction Documents

2.11 CONTROLS

- A. Control Valves: Comply with requirements in Section 230923.11 "Control Valves."
- B. Control Wiring: Factory wire connection for controls' power supply.
- C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
- D. Unit-Mounted Status Panel:
  - 1. Cooling/Off/Heating Controls: Control operational mode.
  - 2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
  - 3. Status Lights:
    - a. Filter dirty.
    - b. Fan operating.
    - c. Cooling operating.
    - d. Heating operating.
    - e. Smoke alarm.
    - f. General alarm.
  - 4. Digital Numeric Display:
    - a. Outdoor airflow.
    - b. Supply airflow.
    - c. Outdoor dry-bulb temperature.
    - d. Outdoor dew point temperature.
    - e. Space temperature.
    - f. Supply temperature.
    - g. Space relative humidity.
- E. Refrigeration System Controls: Per MFG & Engineering Drawings Schedule.
- F. Furnace Controls: Per MFG & Engineering Drawings Schedule.
- G. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:
  - 1. Start/stop interface relay and relay to notify DDC temperature-control system alarm condition.
  - 2. Hardware interface or additional sensors for the following:
    - a. Room temperature.
    - b. Discharge-air temperature.
    - c. Refrigeration system operation.
    - d. Furnace operation.



Construction Documents

- H. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.
  - 1. Industry-accepted, open-protocol communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

2.12 ROOF CURBS: By MFG. See Engineering Drawings.

- A. Wind-Restraint Performance: Wind-Restraint Performance: Unit (& Curb) are installed in a high wind zone and must be permitted to be installed in a 130 MPH wind zone.

2.13 INTAKE AND RELIEF OPENINGS

- A. Type: Manufacturer's standard hood or louver, including moisture eliminator, at all unit intake and relief openings.
- B. Materials: Match material and finish of casing exterior.
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.14 MATERIALS

- A. Steel:
  - 1. ASTM A36/A36M for carbon structural steel.
  - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
  - 1. Manufacturer's standard grade for casing.
  - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.
- F. Corrosion-Resistant Coating: Coat casing, coils and fan guards with a corrosion-resistant coating capable of withstanding a 3,000-hour salt-spray test in accordance with ASTM B117.

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Construction Documents

1. Standards:
  - a. ASTM B117 for salt spray.
  - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
  - c. ASTM D3359 for cross-hatch adhesion of 5B.
2. Application: Immersion or Spray.
3. Thickness: 1 mil.
4. Gloss: Minimum gloss of 50 gloss units on a single angle 60-degree meter.

2.15 SOURCE QUALITY CONTROL

- A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.
- B. AHRI 260 or AMCA 311 Certification: Test and rate air-handling unit fan sound ratings in accordance with AHRI 260 or AMCA Publication 311.
- C. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency.
  1. AMCA Certification: Test and rate in accordance with AMCA Publication 211.
- D. Damper Leakage and Air Performance: Factory test dampers for leakage and air performance.
  1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
- E. Water Coils: Factory tested to 300 psig in accordance with AHRI 410 and ASHRAE 33.
- F. Refrigerant Coils: Factory tested to minimum 300 psig internal pressure and to minimum 300 psig internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.2 INSTALLATION, GENERAL

- A. Roof Curb: Install on roof structure or concrete base, level and secure, in accordance with AHRI Guideline B. Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure units to upper curb

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Construction Documents

rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

- B. Unit Support: Install unit level on structural curbs. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of curbs with actual equipment provided.
  - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- D. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.
- E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."
- F. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- G. Comply with requirements for gas-fired furnace installation in NFPA 54.
- H. Install separate devices furnished by manufacturer and not factory installed.
- I. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Connect piping to units mounted on vibration isolators with flexible connectors.
- D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- E. Gas Piping: Comply with requirements in Section 231123 "Facility Natural-Gas Piping." Provide AGA-approved flexible connectors.
  - 1. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
  - 2. Install AGA-approved flexible connectors.

**Construction Documents**

F. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

**3.4 ELECTRICAL CONNECTIONS**

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

**3.5 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

**3.6 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  2. Inspect units for visible damage to furnace combustion chamber.
  3. 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 flue-gas temperature at furnace discharge.
    - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.

Construction Documents

- e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
4. Verify operation of remote panel, including pilot-light operation and failure modes. Inspect the following:
  - a. High-limit heat exchanger.
  - b. Alarms.
5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
6. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:
  - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
  - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
  - c. Condenser coil entering-air dry-bulb temperature.
  - d. Condenser coil leaving-air dry-bulb temperature.
7. Simulate maximum cooling demand and inspect the following:
  - a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
8. Inspect casing insulation for integrity, moisture content, and adhesion.
9. Verify that clearances have been provided for servicing.
10. Verify that controls are connected and operable.
11. Verify that filters are installed.
12. Clean coils and inspect for construction debris.
13. Clean furnace flue and inspect for construction debris.
14. Inspect operation of power vents.
15. Purge gas line.
16. Verify bearing lubrication.
17. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
18. Adjust fan belts to proper alignment and tension.
19. Start unit.
20. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
21. Operate unit for run-in period.
22. Calibrate controls.
23. Adjust and inspect high-temperature limits.
24. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
25. Verify operational sequence of controls.
26. Measure and record the following airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.
  - b. Relief-air flow.

Construction Documents

c. Outdoor-air flow.

- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.

3.7 ADJUSTING

- A. Adjust initial temperature and humidity 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.

3.8 CLEANING

- A. After completing system installation; testing, adjusting, and balancing dedicated outdoor-air unit and air-distribution systems; and completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, casings, dampers, coils, and filter housings, and install new, clean filters.

3.9 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 with the assistance of a factory-authorized service representative:
  - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

Construction Documents

SECTION 238113.11 - PACKAGED TERMINAL AIR-CONDITIONERS, THROUGH-WALL UNITS

**TIPS:**

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, terminal, through-the-wall air conditioners.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.
  - 2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.

Construction Documents

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:
  - 1. Amana; a division of Whirlpool Corporation.
  - 2. Carrier Corporation.
  - 3. LG Electronics.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 MANUFACTURED UNITS

- A. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with cord-connected chassis.
- 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 CHASSIS

- A. Cabinet: 0.052-inch- thick galvanized or powder-coated steel with removable front panel with concealed latches.
  - 1. Louvers: Style by Architect.
  - 2. Finish: By Architect. Access Door: Hinged door in top of cabinet for access to controls.
  - 3. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
  - 4. Subbase: Enameled steel with adjustable leveling feet and adjustable end plates, with factory-installed and -wired, fused disconnect switch and receptacle sized for unit.
  - 5. Wall Sleeves: Galvanized steel with polyester finish.
- B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with vibration isolation and overload protection.
  - 1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins.
  - 2. Accumulator.
  - 3. Constant-pressure expansion valve.
  - 4. Reversing valve.
  - 5. Charge: R-410A.
- C. Indoor Fan: Forward curved, centrifugal; with motor and positive-pressure ventilation damper with concealed manual operator.
- D. Filters: Washable polyurethane in molded plastic frame.



Construction Documents

- E. Condensate Drain: Drain as indicated on Engineering Drawings
- F. Outdoor Fan: Forward curved, centrifugal-type with separate motor.
  - 1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - a. Fan Motors: Permanently lubricated split capacitor.
    - b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
    - c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.4 HEATING

- A. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

2.5 CONTROLS

- A. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:
  - 1. Low-Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F outdoor air temperature.
  - 2. Heat-Pump Ambient Control: Field-adjustable switch changes to heat-pump heating operation above 40 deg F and to supplemental heating below plus 25 deg F.
  - 3. Reverse-Cycle Defrost: Solid-state sensor monitors frost buildup on [**indoor**] [**outdoor**] coil and reverses unit to melt frost.
- B. Remote Control: As indicated on engineering drawings.
- C. Outdoor Air: Manual intake damper.

2.6 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Factory test to comply with AHRI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."
- B. Unit Performance Ratings: Factory test to comply with AHRI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 2. After installing packaged, terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Packaged, terminal air conditioners will be considered defective if they do not pass tests and inspections.

END OF SECTION 238113.11

Construction Documents

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

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

1.3 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period:

- a. For Compressor: Five year(s) from date of Substantial Completion.
- b. For Parts: One year(s) from date of Substantial Completion.
- c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

- 1. Carrier Corporation.
- 2. Lennox Industries, Inc.; Lennox International.
- 3. Trane.
- 4. Goodman.
- 5. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components:

Construction Documents

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  2. Insulation: Faced, glass-fiber duct liner.
  3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  6. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
  7. Filters: Disposable, replaceable.
  8. Condensate Drain Pans:
    - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - 1) Depth: A minimum of 2 inches deep.
    - b. Single-wall, galvanized-steel sheet.
    - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
      - 1) Minimum Connection Size: NPS 1.
    - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- B. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  3. Fan: Direct drive, centrifugal.
  4. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Construction Documents

- b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  - e. Mount unit-mounted disconnect switches on exterior of unit.
5. Condensate Drain Pans:
- a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
    - 1) Depth: A minimum of 1 inch deep.
  - b. Single-wall, galvanized-steel sheet.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 1) Minimum Connection Size: NPS 1.
  - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
6. Air Filtration Section:
- a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
    - 2) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
  - b. Disposable Panel Filters:
    - 1) Factory-fabricated, viscous-coated, flat-panel type.
    - 2) Thickness: 1 inch.
    - 3) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.

Construction Documents

- b. Refrigerant: R-410A.
  - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
  - 4. Fan: Aluminum-propeller type, directly connected to motor.
  - 5. Motor: Permanently lubricated, with integral thermal-overload protection.
  - 6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Automatic-reset timer to prevent rapid cycling of compressor.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- C. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Outdoor equipment is installed within a high wind zone. Installation to comply with all requirements for 130 MPH wind zone area.
- E. Equipment Mounting:
  - 1. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

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

Construction Documents

- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126





Construction Documents

SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

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**Content Requests:**

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PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

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:
  - 1. Markel Products; TPI Corporation.
  - 2. QMark; Marley Engineered Products.
  - 3. Trane.

Construction Documents

- 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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 custom color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. 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.

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.

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling 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



Construction Documents

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Fire-alarm wire and cable.
5. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

- B. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Cerro Wire LLC.](#)
2. [Encore Wire Corporation.](#)
3. [General Cable Technologies Corporation.](#)
4. [Service Wire Co.](#)
5. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 or ASTM B496 for stranded conductors depending on wire gauges.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Alpha Wire Company.](#)
2. [American Bare Conductor.](#)
3. [Belden Inc.](#)
4. [Cerro Wire LLC.](#)
5. [Encore Wire Corporation.](#)
6. [General Cable Technologies Corporation.](#)
7. [Okonite Company \(The\).](#)
8. [Southwire Company.](#)
9. [WESCO.](#)
10. Additional manufacturers submitted for and receiving engineer approval prior to bid.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.

Construction Documents

2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83

2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  1. [Alpha Wire Company.](#)
  2. [American Bare Conductor.](#)
  3. [Atkore International \(AFC Cable Systems\).](#)
  4. [Belden Inc.](#)
  5. [Encore Wire Corporation.](#)
  6. [General Cable Technologies Corporation.](#)
  7. [Okonite Company \(The\).](#)
  8. [Service Wire Co.](#)
  9. [Southwire Company.](#)
  10. [WESCO.](#)
  11. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- C. Standards:
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  2. Comply with UL 1569.
  3. RoHS compliant.
  4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
  1. Single circuit and multicircuit with color-coded conductors.
  2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors or Aluminum, complying with ASTM B800 and ASTM B801.
- F. Ground Conductor: Bare unless insulated grounding conductor indicated on drawings.
- G. Conductor Insulation:
  1. Type TFN/THHN/THWN-2: Comply with UL 83.
  2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel or Aluminum, interlocked.

Construction Documents

2.4 FIRE-ALARM WIRE AND CABLE

- 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 Wire & Cable Inc.](#)
  2. [CommScope, Inc.](#)
  3. [Comtran Corporation.](#)
  4. [Genesis Cable Products; Honeywell International, Inc.](#)
  5. [nVent \(PYROTENAX\).](#)
  6. [Prysmian Group North America.](#)
  7. [Radix Wire.](#)
  8. [Rockbestos-Suprenant Cable Corp.](#)
  9. [Superior Essex Inc.](#)
  10. [West Penn Wire.](#)
  11. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 12 AWG size as recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
  3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. [3M Electrical Products.](#)
  2. [ABB \(Electrification Products Division\).](#)
  3. [Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.](#)



Construction Documents

4. [Atkore International \(AFC Cable Systems\).](#)
  5. [Gardner Bender.](#)
  6. [Hubbell Incorporated, Power Systems.](#)
  7. [Ideal Industries, Inc.](#)
  8. [ILSCO.](#)
  9. [NSi Industries LLC.](#)
  10. [Service Wire Co.](#)
  11. [TE Connectivity Ltd.](#)
  12. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
1. Copper for feeders smaller than No. 4-4/0 AWG; copper or aluminum for feeders No. 4-4/0 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
1. Copper, Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 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.

Construction Documents

- 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."

3.3 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."
  - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
  - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system.
    - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.4 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-486B.

Construction Documents

- 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.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least-12 inches of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

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."

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."

END OF SECTION 260519



Construction Documents

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. ABB (Electrification Products Division).
  - 2. Advanced Lightning Technology, Ltd.
  - 3. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  - 4. Burndy; Hubbell Incorporated, Construction and Energy.
  - 5. Dossert; AFL Telecommunications LLC.
  - 6. Fushi Copperweld Inc.
  - 7. Galvan Industries, Inc.; Electrical Products Division, LLC.
  - 8. Harger Lightning & Grounding.
  - 9. ILSCO.
  - 10. nVent (ERICO).
  - 11. Robbins Lightning, Inc.
  - 12. Siemens Industry, Inc., Energy Management Division.
  - 13. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

2.3 CONDUCTORS

- A. Insulated Conductors: 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 B3.
  - 2. Stranded Conductors: ASTM B8.
  - 3. Tinned Conductors: ASTM B33.
  - 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.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar. Or Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

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Construction Documents

- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- M. Straps: Solid copper, copper lugs. Rated for 600 A.
- N. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.
- O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- P. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with zinc-plated or stainless-steel bolts.
    - a. Material: Tin-plated aluminum or Die-cast zinc alloy.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 by 96 inches.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

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. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

Construction Documents

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.4 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.



Construction Documents

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.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

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. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

Construction Documents

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
- C. Grounding system will be considered defective if it does not pass tests and inspections.

END OF SECTION 260526

Construction Documents

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. ABB (Electrification Products Division).
    - b. Atkore International (Allied Tube & Conduit).
    - c. Atkore International (Unistrut).
    - d. Eaton (B-line).

Construction Documents

- e. Flex-Strut Inc.
  - f. Gripple Inc.
  - g. GS Metals Corp.
  - h. G-Strut.
  - i. Haydon Corporation.
  - j. Metal Ties Innovation.
  - k. MIRO Industries.
  - l. nVent (CADDY).
  - m. Wesanco, Inc.
  - n. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Galvanized steel, Plain steel, Stainless steel, or Type 304 Stainless steel, Type 316.
  4. Channel Width: Selected for applicable load criteria.
  5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following
1. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  2. Toggle Bolts: All -steel springhead type.
  3. Hanger Rods: Threaded steel.

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Construction Documents

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA 101
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to 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 Wood: Fasten with lag screws or through bolts.

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2. 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 by means that comply with seismic-restraint strength and anchorage requirements.

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.

END OF SECTION 260529

Construction Documents

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. ABB (Electrification Products Division).
  - b. Anamet Electrical, Inc (Anaconda Sealite).
  - c. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  - d. Atkore International (AFC Cable Systems).
  - e. Atkore International (Allied Tube & Conduit).
  - f. Atkore International (Calconduit).
  - g. Electri-Flex Company.

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- h. FSR Inc.
  - i. Korkap.
  - j. NEC, Inc.
  - k. NewBasis.
  - l. Opti-Com Manufacturing Network, Inc (OMNI).
  - m. Patriot Aluminum Products, LLC.
  - n. Perma-Cote.
  - o. Plasti-Bond.
  - p. Republic Conduit.
  - q. Southwire Company.
  - r. Topaz Lighting & Electric.
  - s. Western Tube and Conduit Corporation.
  - t. Wheatland Tube Company.
  - u. Zekelman Industries (Picoma).
  - v. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- 2. 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.
  - 3. GRC: Comply with ANSI C80.1 and UL 6.
  - 4. IMC: Comply with ANSI C80.6 and UL 1242.
  - 5. EMT: Comply with ANSI C80.3 and UL 797.
  - 6. FMC: Comply with UL 1; zinc-coated steel or aluminum.
  - 7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. ABB (Electrification Products Division).
    - b. Anamet Electrical, Inc (Anaconda Sealite).
    - c. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
    - d. Atkore International (AFC Cable Systems).
    - e. Atkore International (Allied Tube & Conduit).
    - f. Atkore International (Calconduit).
    - g. Electri-Flex Company.
    - h. FSR Inc.
    - i. Korkap.
    - j. NEC, Inc.
    - k. NewBasis.
    - l. Opti-Com Manufacturing Network, Inc (OMNI).
    - m. Patriot Aluminum Products, LLC.
    - n. Perma-Cote.
    - o. Plasti-Bond.
    - p. Republic Conduit.
    - q. Southwire Company.



Construction Documents

- r. Topaz Lighting & Electric.
  - s. Western Tube and Conduit Corporation.
  - t. Wheatland Tube Company.
  - u. Zekelman Industries (Picoma).
  - v. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
  - 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  - 5. Fittings for EMT:
    - a. Material: Steel or die cast.
    - b. Type: Setscrew or compression.
  - 6. 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.
  - 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. ABB (Electrification Products Division).
  - b. Anamet Electrical, Inc (Anaconda Sealite).
  - c. Atkore International (AFC Cable Systems).
  - d. Cantex Inc.
  - e. CertainTeed Corporation.
  - f. Champion Fiberglass, Inc.
  - g. Condux International, Inc.
  - h. Electri-Flex Company.
  - i. FRE Composites.
  - j. Kraloy Fittings.
  - k. Lamson & Sessions.
  - l. Niedax Inc.
  - m. Orbia Advance Corporation, S.A.B. de C.V. (Dura-Line Communications Group).
  - n. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
  - o. Topaz Lighting & Electric.

Construction Documents

- p. United Fiberglass of America (UFA).
  - q. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 1. ENT: Comply with NEMA TC 13 and UL 1653.
  - 2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
  - 3. LFNC: Comply with UL 1660.
  
- C. Nonmetallic Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. ABB (Electrification Products Division).
    - b. Anamet Electrical, Inc (Anaconda Sealite).
    - c. Atkore International (AFC Cable Systems).
    - d. Cantex Inc.
    - e. CertainTeed Corporation.
    - f. Champion Fiberglass, Inc.
    - g. Condux International, Inc.
    - h. Electri-Flex Company.
    - i. FRE Composites.
    - j. Kraloy Fittings.
    - k. Lamson & Sessions.
    - l. Niedax Inc.
    - m. Orbia Advance Corporation, S.A.B. de C.V. (Dura-Line Communications Group).
    - n. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
    - o. Topaz Lighting & Electric.
    - p. United Fiberglass of America (UFA).
    - q. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
  - 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
  - 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  - 4. Fittings for LFNC: Comply with UL 514B.
  - 5. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. ABB (Electrification Products Division).
  - 2. Eaton (B-line).

Construction Documents

3. MonoSystems, Inc.
4. nVent (Hoffman).
5. Schneider Electric USA (Square D).
6. Wiegmann; Hubbell Incorporated, Commercial and Industrial.
7. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. ABB (Electrification Products Division).
2. Adalet.
3. Appleton - EGS; Emerson Electric Co., Automation Solutions.
4. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
5. Eaton (Crouse-Hinds).
6. Erickson Electrical Equipment Company.
7. FSR Inc.
8. Hubbell Incorporated.
9. Kraloy Fittings.
10. Milbank Manufacturing Co.
11. MonoSystems, Inc.
12. nVent (Hoffman).

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Construction Documents

13. Oldcastle Enclosure Solutions.
  14. Plasti-Bond.
  15. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
  16. Spring City Electrical Manufacturing Company.
  17. Stahlin Non-Metallic Enclosures.
  18. Topaz Lighting & Electric.
  19. Wiremold; Legrand North America, LLC.
  20. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  21. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
1. Material: Cast metal.
  2. Type: Fully adjustable.
  3. Shape: Rectangular.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes:
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. 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.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.

Construction Documents

- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Gangable boxes are prohibited.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. Cabinets:
  - 1. NEMA 250, Type 1 Type 3R 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.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: IMC
  - 2. Concealed Conduit, Aboveground: EMT
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
  - 1. Exposed, Not Subject to Physical Damage: EMT
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 5. Damp or Wet Locations: IMC.
  - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

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Construction Documents

- C. Minimum Raceway Size: 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew when concealed in building structure or located more than 10' AFF. or compression when accessible to building occupants, steel fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

**Construction Documents**

- I. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 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.
  - 5. Change from ENT to RNC, Type EPC-40-PVC, GRC or IMC before rising above floor.
- L. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. 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.
- N. 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.
- O. 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.
- P. 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.
- Q. 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.

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Construction Documents

2. Where an underground service raceway enters a building or structure.
  3. Conduit extending from interior to exterior of building.
  4. Conduit extending into pressurized duct and equipment.
  5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  6. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- W. Locate boxes so that cover or plate will not span different building finishes.
- X. 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.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Z. Set metal floor boxes level and flush with finished floor surface.



Construction Documents

- AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

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-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  - 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.
5. 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.
- 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, 12" below grade.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

Construction Documents

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

Construction Documents

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. Round sleeves.
  - 2. Rectangular sleeves.
  - 3. Sleeve seal systems.
  - 4. Grout.
  - 5. Pourable sealants.
  - 6. Foam sealants.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Wall Sleeves, Steel:
  - 1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Pipe Sleeves, PVC:
  - 1. Description: ASTM D1785, Schedule 40.
- C. Sheet Metal Sleeves, Galvanized Steel, Round:

## Construction Documents

1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

### 2.2 RECTANGULAR SLEEVES

#### A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:
  - a. Material: Galvanized sheet steel.
  - b. Minimum Metal Thickness:
    - 1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness must be 0.052 inch.
    - 2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

### 2.3 SLEEVE SEAL SYSTEMS

#### A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and 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, Fiber-reinforced plastic, or Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

### 2.4 GROUT

#### A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

### 2.5 POURABLE SEALANTS

#### A. Description: Single-component, 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.

Construction Documents

2.6 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    - b. 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."
  - 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 system 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 Wall Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for wall 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 seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:

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1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

- 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.

END OF SECTION 260544

Construction Documents

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. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Comply with NFPA 70E requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces

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2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field
  - 2. Legend: Indicate voltage and system or service type.
  
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Color for Neutral: White or gray.
  - 5. Color for Equipment Grounds: Bare copper or Green
  - 6. Colors for Isolated Grounds: Green two or more yellow stripes.
  
- C. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.
  
- D. Equipment Identification Labels:
  - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Brady Corporation.
    - b. Champion America.
    - c. emedco.
    - d. Grafoplast Wire Markers.
    - e. HellermannTyton.
    - f. LEM Products Inc.



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- g. Marking Services, Inc.
  - h. Panduit Corp.
  - i. Seton Identification Products; a Brady Corporation company.
  - j. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Brady Corporation.
    - b. HellermannTyton.
    - c. Marking Services, Inc.
    - d. Panduit Corp.
    - e. Seton Identification Products; a Brady Corporation company.
    - f. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. emedco.
    - e. Grafoplast Wire Markers.
    - f. Ideal Industries, Inc.
    - g. LEM Products Inc.
    - h. Marking Services, Inc.
    - i. Panduit Corp.
    - j. Seton Identification Products; a Brady Corporation company.
    - k. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
  - 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend..
  
  - 3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
  
- D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

Construction Documents

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. A'n D Cable Products.
  - b. Brady Corporation.
  - c. Brother International Corporation.
  - d. emedco.
  - e. Grafoplast Wire Markers.
  - f. HellermannTyton.
  - g. Ideal Industries, Inc.
  - h. LEM Products Inc.
  - i. Marking Services, Inc.
  - j. Panduit Corp.
  - k. Seton Identification Products; a Brady Corporation company.
  - l. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
2. Minimum Nominal Size:
  - a. 1-1/2 by 6 inches for raceway and conductors.
  - b. 3-1/2 by 5 inches for equipment.
  - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Brady Corporation.
    - b. HellermannTyton.
    - c. Marking Services, Inc.
    - d. Panduit Corp.
    - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Brady Corporation.
    - b. Panduit Corp.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.

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2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. HellermannTyton.
    - d. Ideal Industries, Inc.
    - e. Marking Services, Inc.
    - f. Panduit Corp.
    - g. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
    - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Brimar Industries, Inc.
    - b. HellermannTyton.
    - c. LEM Products Inc.
    - d. Marking Services, Inc.
    - e. Seton Identification Products; a Brady Corporation company.
    - f. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

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- a. Carlton Industries, LP.
- b. Seton Identification Products; a Brady Corporation company.
- c. Additional manufacturers submitted for and receiving engineer approval prior to bid.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Brady Corporation.
- b. Brimar Industries, Inc.
- c. Ideal Industries, Inc.
- d. LEM Products Inc.
- e. Marking Services, Inc.
- f. Reef Industries, Inc.
- g. Seton Identification Products; a Brady Corporation company.
- h. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Tape:

- a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
- b. Printing on tape shall be permanent and shall not be damaged by burial operations.
- c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
- b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
- c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE"

- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch-

2.6 TAGS

A. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Brimar Industries, Inc.
- b. Carlton Industries, LP.

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- c. LEM Products Inc.
  - d. Seton Identification Products; a Brady Corporation company.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
  3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Carlton Industries, LP.
  - b. Champion America.
  - c. emedco.
  - d. Marking Services, Inc.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Brady Corporation.
  - b. Champion America.
  - c. emedco.
  - d. Marking Services, Inc.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. emedco.
  - d. Marking Services, Inc.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Engraved legend.
3. Thickness:
  - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
  - b. For signs larger than 20 sq. in., 1/8 inch thick.
  - c. Engraved legend with black letters on white face.
  - d. Self-adhesive.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  1. HellermannTyton.
  2. Ideal Industries, Inc.
  3. Marking Services, Inc.
  4. Panduit Corp.
  5. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black, except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- L. Vinyl Wraparound Labels:
  - 1. Secure tight to surface at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

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- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
  - 1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
  - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Write-on Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using general-purpose cable ties.
- X. Baked-Enamel Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.



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2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

**Y. Metal-Backed Butyrate Signs:**

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

**Z. Laminated Acrylic or Melamine Plastic Signs:**

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

**AA. Cable Ties: General purpose, for attaching tags, except as listed below:**

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

**3.2 IDENTIFICATION SCHEDULE**

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120V to Ground: Identify with self-adhesive raceway labels
  1. Locate identification 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.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  1. "EMERGENCY POWER."
  2. "POWER."

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- E. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- F. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- ~~G.~~ Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels
  - 1. Apply to exterior of door, cover, or other access.
  - 2. 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.
- H. Arc Flash Warning Labeling: Self-adhesive labels.
- ~~I.~~ Operating Instruction Signs: Self-adhesive labels
- J. Equipment Identification Labels:
  - 1. Indoor Equipment: Self-adhesive label
  - 2. Outdoor Equipment: Laminated acrylic or melamine sign or Stenciled legend 4 inches high.

END OF SECTION 260553

Construction Documents

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy and vacancy sensors
5. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

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

1.3 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.
6. TE Connectivity Ltd.

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7. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Contact Rating: 20-A ballast load, 120-/240-V ac-
  3. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
  4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program
  5. Astronomic Time: Switches indicated to be astronomical time switch to include astronomical time switch, programmed to switch location, to auto calculate dusk & dawn times.
  6. Automatic daylight savings time changeover.
  7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. [Cooper Industries, Inc.](#)
  2. [Intermatic, Inc.](#)
  3. [Leviton Manufacturing Co., Inc.](#)
  4. [NSi Industries LLC.](#)
  5. [TE Connectivity Ltd.](#)
  6. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Description: Solid state; one set of NO dry contacts rated for 24 V dc at 1 A, to operate connected load, complying with UL 773, and compatible with-power pack-
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
  3. Time Delay: Thirty-second minimum, to prevent false operation.
  4. Mounting: 1/2-inch threaded male conduit.
  5. Failure Mode: Luminaire stays ON.
  6. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
    - a. LED status lights to indicate load status.
    - b. Plenum rated.

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2.3 INDOOR VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Cooper Industries, Inc.
2. Hubbell Control Solutions; Hubbell Incorporated, Lighting.
3. Leviton Manufacturing Co., Inc.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. Lutron Electronics Co., Inc.
6. Schneider Electric USA (Square D).
7. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. General Requirements for Sensors:

1. Wall and Ceiling-mounted, solid-state indoor vacancy sensors.
2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
  - a. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Sensor is powered from the power pack
8. Power: Line voltage-
9. Power Pack: Dry contacts rated for 20-A-LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:
  - a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Color: To match ceiling/wall otherwise selected by architect.

C. Dual-Technology Type: Wall or Corner mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

Construction Documents

2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 20ft coverage from switch when mounted 48 inches above finished floor.
  4. Detection Coverage (Room, Corner Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 20ft coverage from switch when mounted 48 inches above finished floor.
- D. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. [Cooper Industries, Inc.](#)
  2. [Hubbell Control Solutions; Hubbell Incorporated, Lighting.](#)
  3. [Leviton Manufacturing Co., Inc.](#)
  4. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
  5. [Lutron Electronics Co., Inc.](#)
  6. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 20 minutes.
  3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor Tag M0:

Construction Documents

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Concealed, field-adjustable, "off" time-delay selector at up to 20 minutes.
7. Color: Selected by architect.
8. Faceplate: Color matched to switch.

D. Wall-Switch Sensor Tag M6:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: PIR.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage.
6. Concealed, field-adjustable, "off" time-delay selector at up to 20 minutes.
7. Color: Selected by architect.
8. Faceplate: Color matched to switch.

2.5 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [ABB \(Electrification Products Division\)](#).
2. [Allen-Bradley/Rockwell Automation](#).
3. [ASCO: a brand of Vertiv](#).
4. [Eaton](#).
5. [Leviton Manufacturing Co., Inc.](#)
6. [Schneider Electric USA \(Square D\)](#).
7. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, LED, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.
- C. Size conductors in accordance with lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:



Construction Documents

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923



Construction Documents

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Accessory components and features.
5. Identification.

1.2 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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:

Construction Documents

- a. Ambient Temperature: Not exceeding 104 deg F.
- b. Altitude: Not exceeding 6600 feet.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection 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 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. ABB (Electrification Products Division).
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
  - 4. Siemens Industry, Inc., Energy Management Division.
  - 5. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.
- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: Panel mounted.
  - 2. Branch Devices: Panel mounted.
  - 3. Sections front and rear aligned.

Construction Documents

- H. Nominal System Voltage: 208Y/120 V
- I. Indoor Enclosures: Steel, NEMA 250, Type 1-
- J. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Buses and Connections: Three phase, four wire unless otherwise indicated.
  - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
  - 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
  - 3. Tin-plated aluminum feeder circuit-breaker line connections.
  - 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
  - 5. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical compression connectors for feeder and branch-circuit ground conductors.
  - 6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections.
  - 7. Disconnect Links:
    - a. Isolate neutral bus from incoming neutral conductors.
    - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
  - 8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.

Construction Documents

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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long and short time adjustments.
  - d. Ground-fault pickup level, time delay, and I squared t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
  - 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.
  - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
  - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.3 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

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Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Install switchboards and accessories according to NECA 400.
- C. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to switchboards.
  - 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, surge protection devices, and instrumentation.
- H. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
- I. Comply with requirements for terminating cable trays specified in Section 260536 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

Construction Documents

- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections
  - 1. Acceptance Testing:
    - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    - b. Test continuity of each circuit.
  - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Switchboard will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413



Construction Documents

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
  1. Include dimensioned plans, elevations, sections, and details.
  2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  3. Detail bus configuration, current, and voltage ratings.
  4. Short-circuit current rating of panelboards and overcurrent protective devices.
  5. Include evidence of NRTL listing for series rating of installed devices.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet.

Construction Documents

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18-months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Height: 84 inches maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
- E. Phase, Neutral, and Ground Buses: Tin-plated aluminum
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum-
  - 2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
- G. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

Construction Documents

- H. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. ABB (Electrification Products Division).
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
  - 4. Siemens Industry, Inc., Energy Management Division.
  - 5. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Panelboards: NEMA PB 1, 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: See engineering drawings for specifications.
- 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-

2.4 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 the following:
  - 1. ABB (Electrification Products Division).

Construction Documents

2. Eaton.
3. Schneider Electric USA (Square D).
4. Siemens Industry, Inc., Energy Management Division.
5. Additional manufacturers submitted for receiving engineer approval prior to bid.

- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: See engineering drawings for specifications.
- 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.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. ABB (Electrification Products Division).
2. Eaton.
3. Schneider Electric USA (Square D).
4. Siemens Industry, Inc., Energy Management Division.
5. Additional manufacturers submitted for receiving engineer approval prior to bid.

- B. MCCB: Comply with UL 489, with series-connected rating-to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:
  - a. Inverse time-current element for low-level overloads.
  - b. Instantaneous magnetic trip element for short circuits.
  - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
  - a. RMS sensing.
  - b. Field-replaceable rating plug or electronic trip.
  - c. Digital display of settings, trip targets, and indicated metering displays.
  - d. Multi-button keypad to access programmable functions and monitored data.
  - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
  - f. Integral test jack for connection to portable test set or laptop computer.
  - g. Field-Adjustable Settings:
    - 1) Instantaneous trip.
    - 2) Long- and short-time pickup levels.
    - 3) Long and short time adjustments.

Construction Documents

- 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 8. Subfeed Circuit Breakers: Vertically mounted.
- 9. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Breaker handle indicates tripped status.
  - c. UL listed for reverse connection without restrictive line or load ratings.
  - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
  - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  - 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder-

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.

**Construction Documents**

- B. Install panelboards and accessories according to NECA 407.
- C. Mount top of trim such that highest breaker is no more than 79 inches above finished floor (48” for panels in dwelling units) unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

**3.2 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

**3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.

Construction Documents

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

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

END OF SECTION 262416





Construction Documents

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electricity metering

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and utility-furnished components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

- A. Install metering accessories furnished by the utility company, complying with its requirements.
- B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.
  - 1. Data Transmission: Transmit pulse data over control-circuit conductors, classified as Class 1 per NFPA 70, Article 725. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

Construction Documents

- C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets:
  - 1. Comply with requirements of electrical-power utility company.
  - 2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
- E. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, meter socket modules, and feeder circuit breakers arranged in adjacent vertical sections complete with interconnecting buses.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. ABB (Electrification Products Division).
    - b. Eaton.
    - c. Leviton Manufacturing Co., Inc.
    - d. Schneider Electric USA (Square D).
    - e. Siemens Industry, Inc., Energy Management Division.
    - f. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  - 2. Comply with requirements of utility company for meter center.
    - a. Comply with UL 67.
  - 3. Housing: NEMA 250, Type 3R enclosure.
  - 4. Meter Socket Rating: Coordinated with connected feeder circuit rating.
  - 5. Minimum Short-Circuit Rating: Coordinate Short-Circuit Rating with local utility and transformer locations.
  - 6. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.
  - 7. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers and having an adjustable magnetic trip setting for circuit-breaker frame sizes of 250 A and larger. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Circuit breakers shall be operable from outside the enclosure to disconnect the unit. Configure cover so it can be opened only when the disconnect switch is open.
  - 8. Main Disconnect Device: Fusible switch, UL 98 Type GD, series-combination rated by fuse manufacturer to protect downstream feeder and branch circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Switch shall be operable from outside the enclosure to disconnect the unit. Configure cover so that it can be opened only when the disconnect switch is open.
  - 9. Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect downstream circuit breakers and to house load centers and panelboards that have 10,000A interrupting capacity. Confirm interrupting rating with local utility before purchase.

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Construction Documents

- a. Identification: Complying with requirements in Section 260553 "Identification for Electrical Systems."
  - b. Physical Protection: Tamper resistant, with hasp for padlock.
- F. Arc-Flash Warning Labels:
- 1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 260573.19 "Arc-Flash Hazard Analysis." Apply a properly sized self-adhesive label at each work location included in the analysis.
  - 2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a properly sized self-adhesive label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
    - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
      - 1) Location designation.
      - 2) Nominal voltage.
      - 3) Flash protection boundary.
      - 4) Hazard risk category.
      - 5) Incident energy.
      - 6) Working distance.
      - 7) Engineering report number, revision number, and issue date.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to switchboard installation requirements in NECA 400.
- D. Install arc-flash labels as required by NFPA 70.
- E. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 262713



Construction Documents

SECTION 262719 - MULTI-OUTLET ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall-mounted, surface metal raceway multi-outlet assemblies.
2. Floor-mounted, recessed metal raceway multi-outlet assemblies.
3. Fire-rated, poke-through assemblies.

B. Related Requirements:

1. See Section 260533 "Raceway and Boxes for Electrical Systems" for raceways.
2. See Section 262726 "Wiring Devices" for receptacles and switches.
3. See Section 271513 "Communications Copper Horizontal Cabling" for control-voltage communications outlet devices.

1.3 DEFINITIONS

- A. Miniature 8-Position Series Jack (8PSJ): Also called an "8-position 8-contact" (8P8C) modular jack. An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Shape and dimensions are specified by TIA-1096.

1. Caution: This is not the same thing as an FCC "registered jack" RJ45S, now called a miniature "8-position keyed jack" (8PKJ). Ethernet cable plugs do not have rejection keys. Many manufacturers and suppliers incorrectly use "RJ45" as a generic term to describe any 8-position series plug or jack whether or not it has a rejection key.

1.4 ACTION SUBMITTALS

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

Construction Documents

PART 2 - PRODUCTS

2.1 WALL-MOUNTED, SURFACE METAL RACEWAY MULTI-OUTLET ASSEMBLIES

A. Performance Criteria:

1. Description: Two-piece surface metal raceway, field assembled and wired or with factory-wired multioutlet harness, including outlets.
2. Standards:
  - a. Listed and labeled in accordance with UL 5 for exposed power raceway and fittings. Multioutlet assemblies used for communications or data shall also comply with UL 5C for exposed communications raceway and fittings, and UL 2024 for communications cable routing.
  - b. Provide separate paths for management of telecommunications and power cables.
  - c. Listed and labeled in accordance with NFPA 70 and NEMA 250 for intended location and use.

B. Wall-Mounted, Surface Metal Raceway Power Multi-Outlet Assembly:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Wiremold; Legrand North America, LLC.
  - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Product Description: Two-piece surface metal raceway for power outlets.
3. Material: Steel or Aluminum, with manufacturer's standard finish.
4. Color: Selected by architect

C. Wall-Mounted, Surface Metal Raceway Power and Communications Multi-Outlet Assembly:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Wiremold; Legrand North America, LLC.
  - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - c. Additional manufacturers submitted for and receiving engineering approval prior to bid.
2. Product Description: Multi-piece surface metal raceway for power and communications/data outlets with separate raceway channels for power and communications wiring and separate covers for each channel.
3. Material: Steel or Aluminum, with manufacturer's standard finish.
4. Color: Selected by architect.

Construction Documents

2.2 FLOOR-MOUNTED, RECESSED METAL RACEWAY MULTI-OUTLET ASSEMBLIES

A. Performance Criteria:

1. Description: Two-piece flush mounted, in-floor, metal raceway, with factory-wired multioutlet harness, for installation flush in floor or under floor finish.
2. Standards:
  - a. Listed and labeled in accordance with UL 5 for exposed power raceway and fittings, UL 5C for exposed communications raceway and fittings, and UL 2024 for communications cable routing.
  - b. Provide separate paths for management of telecommunications and power cables.
  - c. Listed and labeled in accordance with NFPA 70 and NEMA 250 for intended location and use.

B. Floor-Mounted, Recessed Metal Raceway Power Multi-Outlet Assembly (FLR.):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Wiremold; Legrand North America, LLC.
  - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Product Description: In-floor, flush-mounted raceway with flush or surface-mounted power receptacle outlets. See engineering plans.
3. Color: Selected by architect.

2.3 FIRE-RATED, POKE-THROUGH ASSEMBLIES

A. Performance Criteria:

1. Description: Factory-fabricated assembly of below-floor junction box with multichannel, through-floor raceway/firestop unit with receptacles or communications outlets installed below floor surface level.
2. Standards:
  - a. Listed and labeled in accordance with UL 514A for metallic boxes, or in accordance with UL 514C for nonmetallic boxes, including scrub-water exclusion requirements.
  - b. Provide separate paths for management of telecommunications and power cables.
  - c. Listed and labeled in accordance with NFPA 70 and NEMA 250 for intended location and use.
3. Fire Rating: Provide unit listed and labeled for fire rating assemblies.

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1 for installation requirements, except where requirements on Drawings or in this Section are stricter.
- B. Comply with NECA 101 for installation requirements for steel raceways, except where requirements on Drawings or in this Section are stricter.
- C. Comply with NECA 102 for installation requirements for aluminum raceways, except where requirements on Drawings or in this Section are stricter.
- D. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies.
- E. Provide terminations, adapters, boxes, and other fittings required for the installation.
- F. Install surface raceway with a minimum 2-inch radius control at bend points.
- G. Secure metallic surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no fewer than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are unacceptable support methods.
- H. Do not install aluminum raceways or fittings in contact with concrete.
- I. Comply with Section 260553 "Identification for Electrical Systems."

END OF SECTION 262719



Construction Documents

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: See engineering plans for where 15A receptacles and switches are allowed.
  - 1. Standard-grade receptacles, 125 V, 15 20 A.
  - 2. USB receptacles.
  - 3. GFCI receptacles, 125 V, 20 A.
  - 4. Toggle switches, 120 V, 15 20 A.
  - 5. Decorator-style devices, 15 20 A.
  - 6. Occupancy sensors.
  - 7. Residential devices.
  - 8. Wall-box dimmers.
  - 9. Wall plates.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. 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.
- F. Wall Plate Color: For plastic covers, match device color.
- G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

Construction Documents

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A (Note see “Residential” device sections for 15 A devices in dwelling units, guest rooms and similar)

A. Duplex Receptacles, 125 V, 20 A

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A designated as “TR” on drawings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A indicated as “WP” on drawings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A indicated as "TR,WP" on drawings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 15 A

A. Duplex Receptacles, 125 V, 15 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 15 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  3. Configuration: NEMA WD 6, Configuration 5-15R.
  4. Standards: Comply with UL 498 and FS W-C-596.
  5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 USB RECEPTACLES

A. USB Charging Receptacles: USB

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 1310 and USB 3.0 devices.

2.5 GFCI RECEPTACLES, 125 V, 20 A (Note see "Residential" device sections for 15 A devices in dwelling units, guest rooms and similar)

A. Duplex GFCI Receptacles, 125 V, 20 A (See engineered drawing legend for designations, including but not limited to "GFI")

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

Construction Documents

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
  3. Configuration: NEMA WD 6, Configuration 5-20R.
  4. Type: Feed through.
  5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A indicated as "TR" along with GFI designation (See subsection A)
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Pass & Seymour; Legrand North America, LLC.
    - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
    - c. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  3. Configuration: NEMA WD 6, Configuration 5-20R.
  4. Type: Feed through.
  5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
  6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A Indicated as "TR, WP" along with standard GFI designations (See subsection A)
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Eaton (Wiring Devices - Arrow Hart).
    - b. Leviton Manufacturing Co., Inc.
    - c. Pass & Seymour; Legrand North America, LLC.
    - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
    - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  3. Configuration: NEMA WD 6, Configuration 5-15R.
  4. Type: Feed through.
  5. Standards: Comply with UL 498 and UL 943 Class A.
  6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

Construction Documents

2.6 TOGGLE SWITCHES, 120/277 V, 15 A

A. Single-Pole Switches, 120/277 V, 15 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 15 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Comply with UL 20 and FS W-S-896.
3. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
4. Standards: Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 15 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Comply with UL 20 and FS W-S-896.

Construction Documents

2.7 TOGGLE SWITCHES, 120/277 V, 20 A (Note see “Residential” device sections for 15 A devices in dwelling units, guest rooms and similar)

A. Single-Pole Switches, 120/277 V, 20 A

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Eaton (Wiring Devices - Arrow Hart).
- b. Leviton Manufacturing Co., Inc.
- c. Pass & Seymour; Legrand North America, LLC.
- d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
- e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A indicated as “DP”

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Eaton (Wiring Devices - Arrow Hart).
- b. Leviton Manufacturing Co., Inc.
- c. Pass & Seymour; Legrand North America, LLC.
- d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
- e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A indicated as “3”:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Eaton (Wiring Devices - Arrow Hart).
- b. Leviton Manufacturing Co., Inc.
- c. Pass & Seymour; Legrand North America, LLC.
- d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
- e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Comply with UL 20 and FS W-S-896.

D. Four-Way Switches, 120/277 V, 20 A indicated as “4”

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

Construction Documents

- a. Eaton (Wiring Devices - Arrow Hart).
- b. Leviton Manufacturing Co., Inc.
- c. Pass & Seymour; Legrand North America, LLC.
- d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
- e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Standards: Comply with UL 20 and FS W-S-896.

2.8 OCCUPANCY SENSORS

- A. See Section 260923 – “Lighting Control Devices”

2.9 TIMER LIGHT SWITCH

- A. See Section 260923 – “Lighting Control Devices”

2.10 RESIDENTIAL DEVICES

- A. Residential-Grade, Tamper-Resistant, GFCI Receptacles, 125 V, 15 A indicated “TR” along with GFI designations (See legend on engineered plans)

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Eaton (Wiring Devices - Arrow Hart).
- b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
- c. Leviton Manufacturing Co., Inc.
- d. Pass & Seymour; Legrand North America, LLC.
- e. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Feed-through connectors.
4. Standards: Comply with UL 943 and UL 1699.

- B. Residential-Grade, Tamper-Resistant Receptacles, 125 V, 15 A indicated as “TR”:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. Eaton (Wiring Devices - Arrow Hart).
- b. Leviton Manufacturing Co., Inc.
- c. Pass & Seymour; Legrand North America, LLC.
- d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
- e. Additional manufacturers submitted for and receiving engineer approval prior to bid.



Construction Documents

2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Feed-through connectors.
4. Standards: Comply with UL 498.

C. Weather- and Tamper-Resistant Receptacles, 125 V, 15 A indicated as “TR, WP”:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
  - d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Feed-through connectors.
4. Standards: Comply with UL 498.
5. Marked as "Weather Resistant."

D. Fan-Speed Controls indicated as “F”:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Description: Modular, 120-V ac, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters.
3. Standards: Comply with UL 1917.
4. Coordinate device selection with fan manufacturer.
5. Continuously adjustable toggle switch 1.5 A.

2.11 DIMMERS

A. Wall-Box Dimmers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Lutron Electronics Co., Inc.

Construction Documents

- d. Additional manufacturers submitted for and receiving engineer approval prior to bid.
- 2. Control: Continuously adjustable slider w/ on/off switch; with single-pole or three-way switching.
- 3. Standards: Comply with UL 1472.
- 4. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 10 percent of full brightness.

2.12 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.

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. 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.
  - 2. 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.
  - 3. Install wiring devices after all wall preparation, including painting, is complete.
- C. Device Installation:
  - 1. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  - 2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- D. Receptacle Orientation:
  - 1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

Construction Documents

- E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- F. Dimmers:
  - 1. Install dimmers within terms of their listing.
  - 2. Verify that dimmers used for fan-speed control are listed for that application.
  - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections
- B. Tests for 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.
- 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



Construction Documents

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Panelboards.
  - b. Switchboards.
  - c. Enclosed switches.

1.2 ACTION SUBMITTALS

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

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 the following:
1. Eaton (Bussmann & Edison).
  2. Littelfuse, Inc.
  3. Mersen USA.
  4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

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- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager

3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. ABB (Electrification Products Division).

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2. Eaton.
3. Schneider Electric USA (Square D).
4. Siemens Industry, Inc., Energy Management Division.
5. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Accessories:

1. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. ABB (Electrification Products Division).
2. Eaton.
3. Schneider Electric USA (Square D).
4. Siemens Industry, Inc., Energy Management Division.
5. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. ABB (Electrification Products Division).
2. Eaton.
3. NOARK Electric North America.
4. Schneider Electric USA (Square D).
5. Siemens Industry, Inc., Energy Management Division.
6. Additional manufacturers submitted for and receiving engineer approval prior to bid.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit



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breaker. Circuit breakers shall be 100 percent rated or series rated as indicated on the Drawings. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. \_\_\_\_\_ Amps Available. Identical Replacement Component Required."

- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below
- G. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Long- and short-time pickup levels.
  - 2. Long- and short-time time adjustments.
  - 3. Ground-fault pickup level, time delay, and I-squared t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) for dry area interior devices and gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12) for damp/wet interior or exterior devices

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PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R

3.2 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections
- D. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:

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- a. Inspect physical and mechanical condition.
  - b. Inspect anchorage, alignment, grounding, and clearances.
  - c. Verify that the unit is clean.
  - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
  - e. Verify that fuse sizes and types match the Specifications and Drawings.
  - f. Verify that each fuse has adequate mechanical support and contact integrity.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
  - i. Verify correct phase barrier installation.
  - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

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E. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state

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- components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
- e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.
- 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816



Construction Documents

SECTION 263213.13 - DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged engine generators used to supply non-emergency power, with the following features:
  - 1. Diesel engine.
  - 2. Diesel fuel-oil system.
  - 3. Control and monitoring.
  - 4. Generator overcurrent and fault protection.
  - 5. Generator, exciter, and voltage regulator.
  - 6. Vibration isolation devices.
- B. Related Requirements:
  - 1. Section 263343 "Battery Chargers" for remote engine battery chargers.
  - 2. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 2 years from date of Substantial Completion.

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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. Caterpillar, Inc.; Electric Power Division.
  - 2. Cummins Power Generation.
  - 3. Generac Power Systems, Inc.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
  - 1. Comply with NFPA 37.
  - 2. Comply with NFPA 70.
  - 3. Comply with NFPA 99.
  - 4. Comply with NFPA 110 requirements for Level 1 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier [2] [3] [4] requirements and applicable state and local government requirements.
- E. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Relative Humidity: Zero to 95 percent.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- 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 use.
- C. See engineering drawings for service load, voltage, and phase.

2.4 DIESEL ENGINE

- A. See engineering drawings and additional manufacture specifications for more detail.



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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.
- C. Connect engine exhaust pipe to engine with flexible connector.
- D. Connect fuel piping to engines with a gate valve and union and flexible connector.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.3 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

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- a. Visual and Mechanical Inspection:
    - 1) Compare equipment nameplate data with Drawings and the Specifications.
    - 2) Inspect physical and mechanical condition.
    - 3) Inspect anchorage, alignment, and grounding.
    - 4) Verify that the unit is clean.
  - b. Electrical and Mechanical Tests:
    - 1) Perform insulation-resistance tests according to IEEE 43.
    - 2) Test protective relay devices.
    - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
    - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
  - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  - 6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
  - 7. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  - 8. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet (8 m) from edge of the generator enclosure on the property line, and compare measured levels with required values.
- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

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- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13



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Construction Documents

SECTION 263323.11 - CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interruptible (fast-transfer) central battery equipment rated 600 V and less for emergency lighting:

1.2 DEFINITIONS

- A. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time can be "slow" (up to approximately 1 second) or "fast" (2-4 ms or 40-50 ms, depending on manufacturer).
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and rating of central battery equipment unit.
- B. Shop Drawings: For each type and rating of central battery equipment unit.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
  - 3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
  - 4. Include elevation, details, and legends of control and indication displays.
  - 5. Include -circuit current (withstand) rating of unit.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

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1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.
  - 1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
    - a. Central Battery Equipment (excluding Batteries): Three year(s).
    - b. Standard VRLA Batteries:
      - 1) Pro Rata: Seven years.

PART 2 - PRODUCTS

2.1 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. Cooper Industries, Inc.
  - 2. Dual-Lite.
  - 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 4. IOTA ENGINEERING.
  - 5. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. See engineering plans for specific central battery equipment selected.
- C. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:
  - 1. 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. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924.
  - 3. Comply with the IBC, NFPA 70, and NFPA 101.
- D. Performance Requirements:
  - 1. Automatic Operation:
    - a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.

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- b. If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
  - c. When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
- E. Controls and Indication:
- 1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:
    - a. Normal power available.
    - b. Status of system.
    - c. Battery charging status.
    - d. On battery power.
    - e. System fault.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Comply with NECA 1.
- D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used for low-voltage control and alarm wiring. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
  - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- E. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

Construction Documents

- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.
- H. Install control wiring between central battery equipment and remote devices- Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- I. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 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.
- C. Tests and Inspections:
  - 1. Inspect central battery equipment, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
  - 2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
  - 3. Test continuity of each circuit.
  - 4. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries, battery chargers, and UPS, regardless of the type of central battery equipment provided. Certify compliance with test parameters.
  - 5. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.
  - 6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Central battery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.



Construction Documents

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions.

END OF SECTION 263323.11



Construction Documents

SECTION 263343 - BATTERY CHARGERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes battery chargers for emergency engine generators.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of battery charger.

1.3 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of battery chargers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 1236 for Category BBHH. OEM-supplied, open-frame chargers may be UL recognized to Category BBHH provided they are housed in a listed enclosure.
- C. NFPA Compliance: Comply with NFPA 110.
- D. Environmental Conditions: Battery charger shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Relative Humidity: 5 to 95 percent.

Construction Documents

2.2 BATTERY CHARGERS FOR EMERGENCY ENGINE GENERATORS

- 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. Cummins Power Generation.
  - 2. GE Power; General Electric Company.
  - 3. Stored Energy Systems LLC.
  - 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.
  
- B. Battery-Charger Operation: Current-limited, constant voltage, boost-and-float-type charger designed for batteries, with the following features:
  - 1. Output Voltage Regulation: Charger regulates output to within plus or minus 0.5 percent of manufacturer-provided voltage settings despite variations of input voltage, input frequency, and output current.
  - 2. Battery Thermal Compensation: Battery temperature compensation with adjustable slope, factory set at minus 0.18 percent per degree C, and equipped for sensing battery temperature.
  - 3. Automatic Dead Battery Recharge: Charger automatically recharges a battery discharged to 0 V at full-rated output current, without the need for user intervention.
  - 4. AC Input: Charger operates from any 47- to 63-Hz ac source with voltage ranging from 90- to 265-V rms.
  - 5. Lead-Acid Battery Longevity and Safety Mode: Charger emulates vehicle duty for which starting batteries are designed to maximize battery life, minimize battery explosion risk, and minimize electrolyte loss in lead-acid batteries.
  - 6. Charger Enclosure: NEMA 250, Type 3R (IP22), wall mounted and rated for generator duty with charger enclosure vibration resistance. Housing materials: aluminum or stainless steel.
  - 7. Battery-Charger Status Indication: Output voltage and current meters on front panel.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled battery chargers to manufacturer's written instructions. Verify NFPA 110 recharge performance by validating that battery charger is listed to UL 1236 Category BBHH on the UL certification database.
  
- B. Battery charger will be considered defective if it does not pass tests and inspections.
  
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 BATTERY-CHARGER INSTALLATION

- A. Examine areas, mounting locations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting battery-charger performance.

Construction Documents

- B. Follow manufacturer's written instructions to prevent damage from static electricity. Provide clearances for service and ventilation.
- C. Identify system components according to Section 260553 "Identification for Electrical Systems."

3.2 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide branch-circuit overcurrent protection.
- C. Comply with requirements for branch-circuit protection and service disconnects in Section 262816 "Enclosed Switches and Circuit Breakers."

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Verify that certification labels are properly installed. Verify NFPA 110 compliance by validating that battery charger is listed to UL 1236 Category BBHH on the UL certification database.
  - 2. Verify that connections are secure and in the proper locations. Ensure wiring is correctly connected between charger and battery.
  - 3. Operational Test: After electrical circuitry has been energized, apply input voltage to confirm proper unit operation.
  - 4. Test and adjust alarms, display indicators, controls, and safeties.
- C. Battery charger will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain battery chargers and related equipment.

END OF SECTION 263343



Construction Documents

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes automatic and nonautomatic transfer switches rated 600 V and less.

1.2 ACTION SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.

Construction Documents

- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- K. Service-Rated Transfer Switch:
  - 1. Comply with UL 869A and UL 489.
  - 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
  - 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
  - 4. Provide removable link for temporary separation of the service and load grounded conductors.
  - 5. Surge Protective Device: Service rated.
  - 6. Ground-Fault Protection: Comply with UL 1008 for normal and alternative buses.
  - 7. Service Disconnecting Means: Externally operated, manual [**mechanically**] [**electrically**] actuated.
- L. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 AUTOMATIC / MANUAL TRANSFER SWITCHES

- 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. ABB, Electrification Products Division.
  - 2. Caterpillar, Inc.; Electric Power Division.



Construction Documents

3. Eaton.
4. Generac Power Systems, Inc.
5. Additional manufacturers submitted for and receiving engineer approval prior to bid.

- B. See engineering plans and additional manufacturer's specifications for information on transfer switches

2.3 SOURCE QUALITY CONTROL

- A. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
  - a. Overvoltage.
  - b. Undervoltage.
  - c. Loss of supply voltage.
  - d. Reduction of supply voltage.
  - e. Alternative supply voltage or frequency is at minimum acceptable values.
  - f. Temperature rise.
  - g. Dielectric voltage-withstand; before and after short-circuit test.
  - h. Overload.
  - i. Contact opening.
  - j. Endurance.
  - k. Short circuit.
  - l. Short-time current capability.
  - m. Receptacle withstand capability.
  - n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See engineering drawings for transfer switch location.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- D. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

Construction Documents

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Route and brace conductors according to manufacturer's written instructions, and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- E. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify that the unit is clean.
    - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    - f. Verify that manual transfer warnings are attached and visible.
    - g. Verify tightness of all control connections.
    - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
      - 1) Use of low-resistance ohmmeter.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
    - i. Perform manual transfer operation.
    - j. Verify positive mechanical interlocking between normal and alternate sources.
    - k. Perform visual and mechanical inspection of surge arresters.
    - l. Inspect control power transformers.
      - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
      - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
      - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

Construction Documents

2. Electrical Tests:
  - a. Perform insulation-resistance tests on all control wiring with respect to ground.
  - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
  - c. Verify settings and operation of control devices.
  - d. Calibrate and set all relays and timers.
  - e. Verify phase rotation, phasing, and synchronized operation.
  - f. Perform automatic transfer tests.
  - g. Verify correct operation and timing of the following functions:
    - 1) Normal source voltage-sensing and frequency-sensing relays.
    - 2) Engine start sequence.
    - 3) Time delay on transfer.
    - 4) Alternative source voltage-sensing and frequency-sensing relays.
    - 5) Automatic transfer operation.
    - 6) Interlocks and limit switch function.
    - 7) Time delay and retransfer on normal power restoration.
    - 8) Engine cool-down and shutdown feature.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
  - a. Check for electrical continuity of circuits and for short circuits.
  - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
4. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
  - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
  - f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

Construction Documents

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
  - a. Verify grounding connections and locations and ratings of sensors.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Transfer switches will be considered defective if they do not pass tests and inspections.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.
- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

Construction Documents

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes lightning protection system for the following:
  - 1. Ordinary structures.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. <u>Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. Advanced Lightning Technology, Ltd.
  - 2. East Coast Lightning Equipment Inc.
  - 3. Harger Lightning & Grounding.
  - 4. Heary Bros. Lightning Protection Co. Inc.
  - 5. Independent Protection Co.
  - 6. National Lightning Protection.
  - 7. nVent (ERICO).
  - 8. Preferred Lightning Protection.
  - 9. Robbins Lightning, Inc.
  - 10. Thompson Lightning Protection, Inc.
  - 11. Additional manufacturers submitted for receiving engineer approval prior to bid.

2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.
- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
- C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building.
- D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose
- C. 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.

3.3 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Perform inspections as required to obtain a UL Master Label for system.
  - 2. Perform inspections to obtain an LPI certification.
- B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

Construction Documents

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinders.
2. Downlight.
3. Strip light.
4. Surface mount, linear.
5. Surface mount, nonlinear.
6. Suspended, nonlinear.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.

Construction Documents

- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.5 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 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F:
  - 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 5000 feet.

2.2 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. 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.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.3 CYLINDER.

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. [Juno Lighting Group by Schneider Electric.](#)
  - 2. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
  - 3. [Sea Gull Lighting.](#)



Construction Documents

4. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. [See engineering drawings for specifications of lighting fixtures.](#)

2.4 DOWNLIGHT.

A. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Juno Lighting Group by Schneider Electric.](#)
2. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
3. [Sea Gull Lighting.](#)
4. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. [See engineering drawings for specifications of lighting fixtures.](#)

2.5 STRIP LIGHT.

A. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Eaton \(Lighting\).](#)
2. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
3. [Signify North America Corporation \(formerly Philips Lighting\).](#)
4. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. [See engineering drawings for specifications of lighting fixtures.](#)

2.6 SURFACE MOUNT, LINEAR.

A. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Eaton \(Lighting\).](#)
2. [Elite Lighting Corporation.](#)
3. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
4. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. [See engineering drawings for specifications of lighting fixtures.](#)

2.7 SURFACE MOUNT, NONLINEAR

A. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Eaton \(Lighting\).](#)

Construction Documents

2. [Elite Lighting Corporation.](#)
3. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
4. [Peerless; Acuity Brands Lighting, Inc.](#)
5. [Signify North America Corporation \(formerly Philips Lighting\).](#)
6. [Tech Lighting.](#)
7. Additional manufacturers submitted for receiving engineer approval prior to bid.

- B. [See engineering drawings for specifications of lighting fixtures.](#)

2.8 SUSPENDED, LINEAR.

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Eaton \(Lighting\).](#)
2. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
3. [Tech Lighting.](#)
4. Additional manufacturers submitted for receiving engineer approval prior to bid.

- B. [See engineering drawings for specifications of lighting fixtures.](#)

2.9 SUSPENDED, NONLINEAR.

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Eaton \(Lighting\).](#)
2. [Edge Lighting.](#)
3. [Elite Lighting Corporation.](#)
4. [Focal Point LLC.](#)
5. [Lithonia Lighting; Acuity Brands Lighting, Inc.](#)
6. Additional manufacturers submitted for receiving engineer approval prior to bid.

- B. [See engineering drawings for specifications of lighting fixtures.](#)

2.10 MATERIALS

- A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

- B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

Construction Documents

- C. Stainless Steel:
  - 1. 1. Manufacturer's standard grade.
  - 2. 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.11 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.

2.12 LUMINAIRE SUPPORT

- 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 A641/A641M, 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.

Construction Documents

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 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.

3.4 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

END OF SECTION 265119

Construction Documents

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Emergency lighting units.
  - 2. Exit signs.
  - 3. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.

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Construction Documents

- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for recessed luminaires.
- F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
  - 1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 2. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
  - 3. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  - 6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- G. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
  - 1. Emergency Connection: Operate LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3. Nightlight Connection: Operate lamp in a remote fixture continuously.
  - 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 5. Charger: Fully automatic, solid-state, constant-current type.
  - 6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.

Construction Documents

7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Dual-Lite.
  - b. Eaton (Lighting).
  - c. Juno Lighting Group by Schneider Electric.
  - d. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Emergency Luminaires: as indicated on Interior Luminaire Schedule Drawings, with the following additional features:
  - a. Operating at nominal voltage of 120 V ac
  - b. External emergency power unit.
  - c. Rated for installation in damp locations, and for sealed and gasketed fixtures in wet locations.

C. Emergency Lighting Unit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Dual-Lite.
  - b. Eaton (Lighting).
  - c. Evenlite, Inc.
  - d. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - e. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Emergency Lighting Unit: as indicated on Interior Luminaire Schedule Drawings.
3. Operating at nominal voltage of 120 V ac.
4. Wall with universal junction box adaptor.
5. Two LED lamp heads.
6. Internal emergency power unit.
7. External emergency power unit.

Construction Documents

2.3 EXIT SIGNS

A. Internally Lighted Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Eaton (Lighting).
  - b. Evenlite, Inc.
  - c. Hubbell Incorporated, Lighting.
  - d. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - e. Kenall.
  - f. Additional manufacturers submitted for and receiving engineer approval prior to bid.
2. Operating at nominal voltage of 120 V ac.
3. See engineering plans for how exit signs are powered.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Conduit: Electrical metallic tubing minimum 3/4 inch in diameter.

2.5 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.



Construction Documents

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire and emergency power unit weight.
  - 2. Able to maintain luminaire position when testing emergency power unit.
  - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.
- E. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls-
  - 2. Do not attach fixtures directly to gypsum board.
- F. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
- H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

Construction Documents

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 265213

Construction Documents

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

B. Related Requirements:

1. **Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.**
2. **Section 260926 "Lighting Control Panelboards" for panelboard-based lighting control.**

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

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

1.4 FIELD CONDITIONS

- A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

Construction Documents

1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 2 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. Nominal Operating Voltage: 120 V ac-
- C. Lamp Rating: Lamp marked for outdoor use.
- D. Source Limitations:
  - 1. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

- A. Exterior Fixtures:
  - 1. See Engineering drawings for specifications of lighting fixtures.
  - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Eaton (Lighting).
    - b. H.E. Williams.
    - c. Juno Lighting Group by Schneider Electric.
    - d. Lithonia Lighting; Acuity Brands Lighting, Inc.
    - e. RAB Lighting.
    - f. Signify North America Corporation (formerly Philips Lighting).
    - g. Additional manufacturers submitted for receiving engineer approval prior to bid.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- 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

**Construction Documents**

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

**C. Diffusers and Globes:**

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

**D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.****E. Housings:**

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

**2.4 FINISHES****A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.****B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.****C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.**

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
  - a. Color: Selected by architect.

Construction Documents

- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color:
      - 1) As selected from manufacturer's standard catalog of colors.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls-
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

Construction Documents

- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

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. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. 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. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    - a. IES LM-5.
    - b. IES LM-50.
    - c. IES LM-52.
    - d. IES LM-64.
    - e. IES LM-72.
  - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

Construction Documents

- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619



**STS-1000**  
**TELECOMMUNICATIONS**  
**WIRING GUIDELINES**



**STATE TELECOMMUNICATIONS SERVICES**  
**919-981-5555**

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## 1.0 INTRODUCTION

### 1.1 Subject:

Telecommunications wiring guidelines apply to the State of North Carolina Executive Branch Agencies. Notwithstanding any other provision of law, North Carolina universities, community colleges, public school systems and local governmental entities may use the information technology programs, services, or contracts offered by the Office of Information Technology Services, including information technology procurement, in accordance with the statutes, policies, and rules of the Office of Information Technology Services. "Local governmental entities" includes local school administrative units, as defined in G.S. 115-C5, and community colleges. Local governmental entities are not required to comply with otherwise applicable competitive bidding requirements when using contracts established by the Office of Information Technology Services. Any other State entities may also use the information technology programs, services, or contracts established by the Office of Information Technology Services, including information technology procurement, in accordance with the statutes, policies, and rules of the Office of Information Technology Services.

### 1.2 Intent:

It is desired to have a uniform wiring plan for voice, data, image, and video to allow flexibility for personnel changes, office renovations and equipment migration and updates. This cabling system is based on a structured cabling system that is not vendor proprietary and conforms to the TIA / EIA-568-B Commercial Building Wiring Standards. **This document is meant to be dynamic and will change as official standards change.**

### 1.3 Authority:

N.C.G.S. 147-33.91 States the Powers and Duties of the Office of Information Technology Services. N.C.G.S. 147-33.82 States the Power of the State of NC Chief Information Officer (CIO).

### 1.4 Scope:

These guidelines are intended to provide advisory information for all new state buildings and major renovations. For retrofitting and telecommunications recabling, these guidelines should be used unless there is a strong business case for not doing so. Specifically these guidelines are for wiring in:

- \* Newly constructed buildings
- \* Buildings undergoing major renovations
- \* New long-term leased occupancy
- \* New multi-building networks with state owned fiber or wire cable

## 1.5 Hazardous Material Handling:

ANY CONTRACTOR WORKING UNDER CONTRACTUAL AGREEMENT WITH ANY STATE AGENCY, PUBLIC SCHOOL SYSTEM, COMMUNITY COLLEGE, UNIVERSITY, COUNTY, CITY OR LOCAL GOVERNMENTAL AGENCY WITHIN THE STATE OF NORTH CAROLINA SHALL BE RESPONSIBLE FOR CONTACTING THE OWNER OF ANY BUILDING (S) IN WHICH THE DESCRIBED WORK UNDER CONTRACT IS TO BE PERFORMED TO DETERMINE WHETHER ASBESTOS CONTAINING MATERIALS (ACM) AND/OR PRESUMED ASBESTOS CONTAINING MATERIALS (PACM) ARE LOCATED IN SAID BUILDING (S). ONCE THE EXISTENCE OF ACM OR PACM HAS BEEN IDENTIFIED, IT SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY TO TAKE NECESSARY SPECIAL PRECAUTIONS AND ACTIONS TO PROTECT ITS EMPLOYEES, SUBCONTRACTORS, THE GENERAL PUBLIC, AND THE BUILDING AND STRUCTURE FROM EXPOSURE TO ASBESTOS WHILE PERFORMING ANY WORK UNDER CONTRACT. THE CONTRACTOR SHALL COMPLY WITH ALL RULES AND GUIDELINES SPECIFIED BY OSHA, EPA, AND THE CLEAN AIR ACT, AND ALL OTHER APPLICABLE LAWS RELATING TO THE EXISTENCE OF OR EXPOSURE TO ACM OR PACM.

These guidelines are based on TIA / EIA-568-B Commercial Building Telecommunications Wiring Standard and the latest published version of Building Industry Consulting Service International's (BICSI) Telecommunications Distribution Methods Manual and Customer Owned Outside Plant Manual. The BICSI manuals are a good source for detailed planning of telecommunications distribution systems.

These guidelines do not recommend a particular method of horizontal distribution (under floor, ceiling, under carpet, etc.) because of the wide disparity of buildings and designers used in this state. The BICSI manual cited above and the TIA / EIA - 569 are excellent references and should be followed for more detail on horizontal pathways and spaces.

The National Electrical Code (**NEC**) adopted by the State of NC, the National Electrical Safety Code (**NESC**) and other national, state and local building codes are recognized as having jurisdiction over related parts of these guidelines.

## 1.6 Purpose:

These guidelines are intended to give recommended minimum requirements for telecommunications service in general and administrative office space. This guideline addresses the physical pathways, media, and cable administration practices.

The purpose is threefold:

- To provide direction.
- To enable the planning of telecommunications facilities with little knowledge of the specific products that will be installed.

- To define a generic telecommunications wiring system that will support most state agency wiring needs in a multi-vendor and multi-product environment.

## 2.0 APPROACH

These guidelines follow the general cabling industry practice of using a "structured cabling system" (SCS). An SCS attempts to wire a building for information needs without knowing specifically what equipment will be utilized. An SCS is geared for long-term stability and flexibility and is based on the idea of wiring the building once. Figure 1 is an abbreviated pictorial of such a system. The structured cabling system approach allows the wire and outlets to remain unchanged while the connections and services vary. The main components of a structured cabling system are:

- \* Common Media - Unshielded twisted pair (UTP) and fiber optic cables are capable of supporting voice, image and data communications. Services can change without affecting the media used to connect the services.
- \* Star Topology - Media is distributed only from designated distribution points (rooms) within the system. The signal quality improves because the number of connections is limited.
- \* Cross-connects – Cross-connects and patch panels provide the system with the flexibility to make changes to the service quickly and easily using jumper wires or modular jacks. Agency personnel with little training can make changes to the service in the work area, thereby reducing the amount of time, effort, and cost in making changes.
- \* Universal outlet - Common universal outlets provide a standard interface that permits connectivity of devices to any service by changing the connection to the outlet and not the outlet itself. Connection to the outlet can be done directly or by using adapters when necessary.
- \* Administration - An administrative system is used to record installations and should be maintained on a continuing basis.

## 3.0 WIRING SYSTEM ELEMENTS

### 3.1 Horizontal cabling / wiring:

Horizontal cable and connecting hardware provide the means of transporting telecommunications signals between the telecommunications outlet / connector in the work area and the horizontal cross-connect in the telecommunications room. These components are the “contents” of the horizontal pathways and spaces. **It is the State of NC minimum standard that the cabling shall be UTP Category 5e with pathway planning for fiber and or copper growth. The State of NC highly recommends researching costs vs. benefits of installing higher Categories (Category 6 & Category 6 Augmented) of Cabling in all new and renovated locations that do not presently have horizontal cabling installed.**

### 3.2 Telecommunications rooms:

The telecommunications room on each floor is a transition point between the backbone and horizontal distribution pathways. The telecommunications room shall be able to

contain telecommunications equipment, cable terminations, and associated cross-connection wiring. It is here that the logical topology wiring is accomplished. The physical star workstations may be connected in ring or bus topologies in addition to star.

### 3.3 Backbone wiring:

Backbone wiring is the riser wiring and / or telecommunications room/s interconnecting wiring in multi-story buildings or the main distribution system in a campus environment. It should be fiber optic cable, unless a strong business case can be made for UTP Category 5e or Category 6 for data and UTP Category 3 minimum for analog voice feeder cable.

### 3.4 Entrance facility:

This is the pathway where a service enters a property or building including the entrance point at the building wall and continuing to the entrance room or space. The demarcation point between the service provider and the user is typically located in the entrance room.

### 3.5 Campus distribution:

This is the interbuilding connectivity and campus backbone in a complex or multi-building environment.

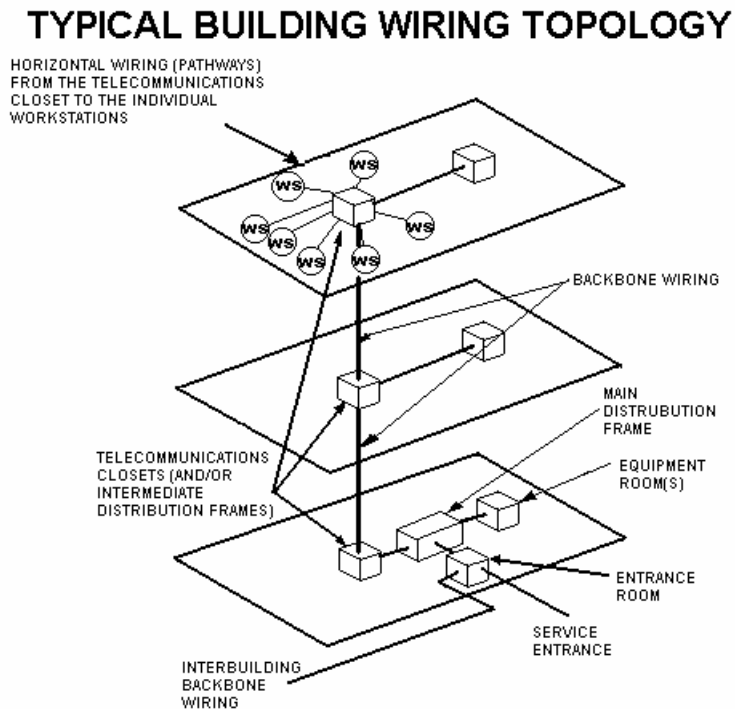


Figure 1 Structured Wiring Diagram

## 4.0 HORIZONTAL WIRING

### 4.1 Structure:

The horizontal wiring structure extends from the telecommunications room to the telecommunications outlet. It includes the outlet / connector, the horizontal distribution system cables, the cross-connect in the room and Horizontal Pathways and Spaces. Pathways and spaces are used to distribute and support horizontal cable and



connecting hardware between the work area outlet and the telecommunications room. These pathways are the “container” for the horizontal cabling.

Note: Horizontal cables do not include work area (patch) cables or equipment room (patch) cables. However, the length and type of cable required for connecting telecommunications equipment to the horizontal cabling will significantly affect end-to-end system performance and should be taken into consideration when planning any system.

## 4.2 Major items:

The major points of the horizontal system are:

- \* Horizontal pathways and spaces are generally referred to as “horizontal distribution systems” and consist of structures that conceal, protect, and support horizontal cables between the telecommunications outlet / connector used to connect work area equipment (voice, data, and video) at the work area and horizontal cross-connect in the serving telecommunications room.

Select and design the type and layout of the horizontal distribution systems carefully. After a building is constructed, it may be more difficult to gain access to horizontal cabling. Therefore the skill, effort, and time required to make horizontal cabling changes can be very high. When selecting and designing horizontal distribution systems, it is important to consider the design’s ability to accommodate cabling changes and minimize occupant disruption when horizontal pathways and spaces are accessed.

In addition to providing for current occupant needs, the horizontal distribution system design must facilitate ongoing maintenance of horizontal cabling and accommodate future additions to and changes in cabling, equipment and services.

The pathway design should allow for a minimum of three cables run per individual work area. Although minimally, only two cables are required, the additional pathway capacity is needed to facilitate future additions and changes as the user’s needs evolve.

### 4.2.1 Conduit Cable Capacity:

The following table provides guidelines used by ANSI / TIA / EIA – 569 for cable fill capacity for conduits ranging from ½-inch trade size to 4-inch trade size that have no more than two 90 degree bends (180 degrees total) and are no longer than 100 feet. The number of cables that can be installed is actually limited by the allowed maximum pulling tensions of the cables.

**IMPORTANT:** Flexible conduit is not recommended for use in buildings because it tends to creep, shift and damage cable sheaths. Use only in situations where it is the only practical alternative and increase the conduit size by one trade size.

Conduit Inside Diameter (Inches)	Conduit Trade Size (Inches)	Cable Outside Diameter (Inches)									
		0.13	0.18	0.22	0.24*	0.29	0.31	0.37	0.53	0.62	0.70
.629	1/2	1	1	0	0	0	0	0	0	0	0
.826	3/4	6	5	4	3	2	2	1	0	0	0
1.06	1	8	8	7	6	3	3	2	1	0	0
1.37	1-1/4	16	14	12	10	6	4	3	1	1	1
1.61	1-1/2	20	18	16	15	7	6	4	2	1	1
2.08	2	30	26	22	20	14	12	7	4	3	2
2.48	2-1/2	45	40	36	30	17	14	12	6	3	3
3.07	3	70	60	50	40	20	20	17	7	6	6
3.58	3-1/2							12	12	7	6
4.05	4							30	14	12	7

**Table of Conduit Capacities for Various Sized UTP Cabling used by ANSI / TIA / EIA-569-A**

\* Typical sizes for Cat 5e - UTP Cables

**NOTE:** New requirements were added to the National Electrical Code in 2002 for removal of abandoned cables:

- |                              |  |
|------------------------------|--|
| 645.5 (D) (6)                | Information technology equipment rooms |
| 760.3 (A)                    | Fire alarm systems                     |
| 770.3 and 770.54 (B)         | Fiber optics                           |
| 800.52 (B)                   | Communications circuits                |
| 820.3 (A) and 820.53 (B) (1) | CATV and radio distribution systems    |

Avoiding potential sources of electromagnetic interference (e.g., motors and transformers that share distribution space & copiers used in work areas) must be a primary consideration when designing horizontal pathways.

All horizontal pathways that penetrate fire-rated barriers shall be fire stopped in accordance with applicable codes.

When telecommunications horizontal pathways or cabling are placed in a hazardous location, such as an explosive or combustible atmosphere, observe all requirements of the applicable electrical code.

The main types of horizontal pathways are:

Conduit. Cable Tray. Ladder Rack. Under Floor ducts.  
Access (raised) floors. J-Hooks. Cellular floors.  
Ceiling Zones. Mechanically Fastened Raceways.

Many buildings require a combination of two or more of these systems to meet all distribution needs. For example, an office area in a building may require an under floor or overhead system, while an isolated telecommunications outlet location may best be served by an individual conduit.

Overhead cabling above ceiling tiles shall be attached to an appropriate support system connected to the building structure rather than the ceiling tile grid or hangers. Special consideration shall be given to length of cable span between supports and maximum number of cables in a support for cable Category Compliance. [The maximum unsupported cable span when using Category Compliant hangers (often referred to as J-hooks) for open wire cable systems shall be no more than 5 ft. and the typical number of .25 in. diameter cables supported by either shall not exceed the hanger manufacturer's specifications for Category Compliance. A dual run shall be counted as 2 cables but one dual drop.] For large quantities of cables (50 to 75) that convene at the telecommunications room and other areas, provide sufficient support that is specifically designed to support the required cable weight and volume while maintaining Category Compliance (no more than 12 inches of cable sag between supports). There shall be a minimum of three inches of clearance between the cable support system and the ceiling tile support grid. Plenum rated cable shall be used if the space above the ceiling tile system is an environmental air space.

- \* In the "ceiling zones" method of ceiling distribution, divide the usable floor area into zones of 365 square ft. to 900 square ft. each. When convenient, it is preferable that zones be divided by building support columns. Cabling to each zone may be placed within the ceiling plenum area (where permitted by applicable codes) or installed in enclosed conduits or raceways. The pathways should extend from the telecommunications room to the mid-point of the zone. From that point,

the cables (or pathway) should be extended to the top of the utility columns or wall, then down to work area outlet boxes.

- \* Horizontal cabling must be designed to accommodate diverse user applications including:
  - Voice Communications
  - Data Communications
  - Local area networks (LANs)

The designer should also consider incorporating other building information systems (e.g., CATV, alarms, security, audio, video, automated building systems and other telecommunications systems) when selecting and designing horizontal cabling. In addition to accommodating existing telecommunications needs, consider accommodating a diversity of applications in order to reduce or even eliminate the need for horizontal cabling changes as user requirements evolve.

- \* Star topology - each work area outlet shall be cabled directly to a horizontal cross-connect in the telecommunications room. This does not preclude physical bus and ring topology; this is done in the telecommunications room.

Splices are not permitted for twisted-pair horizontal cabling. Bridged taps (multiple appearances of the same cable pairs at several distribution points) are not permitted in horizontal cabling.

- \* Advanced planning considers the use of fiber optic cabling to all training rooms, conference rooms and computer rooms. On a business case basis, pathways of innerduct, raceways and conduit are to be provided to support the use of fiber optic cabling.
- \* Cable length maximums are specific to the media itself - e.g. 90 meters (295 feet) for UTP cabling from the horizontal cross-connect to the outlet / connector and 6 meters (20 feet) for patch cords and cross-connect jumpers in the horizontal cross-connect.

In establishing limits on horizontal cable lengths, a 10m (33 ft.) allowance was made for combined length of patch cables and cables used to connect equipment in the work area and telecommunications room. All equipment cables should meet or exceed the same performance requirements as the patch cords.

The 6m (20 ft.) maximum length specified for patch cables does not include additional cable lengths needed to connect to active equipment. For example, if 3m (10 ft.) of cable are used for each work area connection, the 10 m (33 ft.) total allowance provides for up to 7m (23 ft.) of combined length per channel for patch cables and equipment cables in the telecommunications room.

### 4.3 Outlets and Jacks:

#### 4.3.1 Cable and Jack Specifications:

This suggested configuration would serve most needs. It consists of four pairs (8 wires) of unshielded twisted pair (UTP) for voice and another four pairs for data applications. These cables shall be Category 5e UTP cables as a **minimum standard**. **The State of NC highly recommends researching costs vs. benefits of installing higher Categories (Category 6 & Category 6 Augmented) of Cabling in all new and renovated locations that do not presently have horizontal cabling installed.** The performance for these cables shall be defined by TIA / EIA 568-B.

All voice and data pairs are terminated in RJ45 wiring configuration. The outlet looks like a regular telephone jack to the casual observer. This jack shall be Category 5e compliant or higher as defined by TIA / EIA-568-B. These jacks shall be wired with the T568A pinout configuration. A faceplate shall be provided.

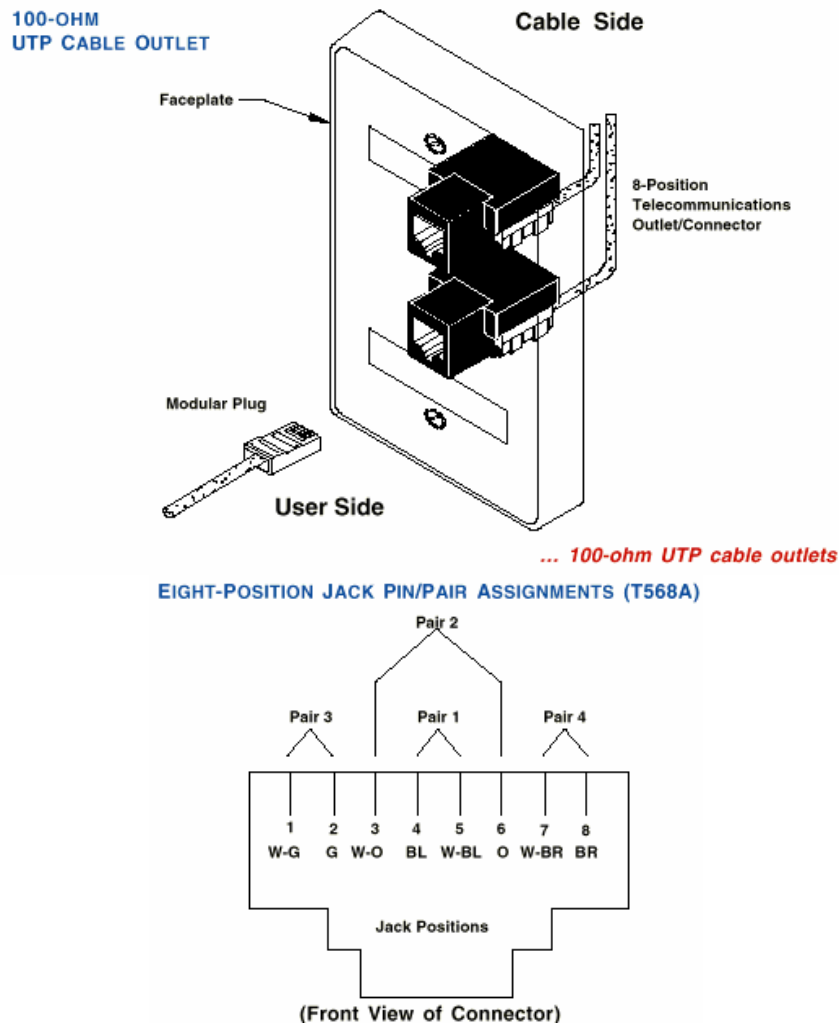


Figure 2 T568A Jack Pinout

## HORIZONTAL CABLING SCHEMATIC

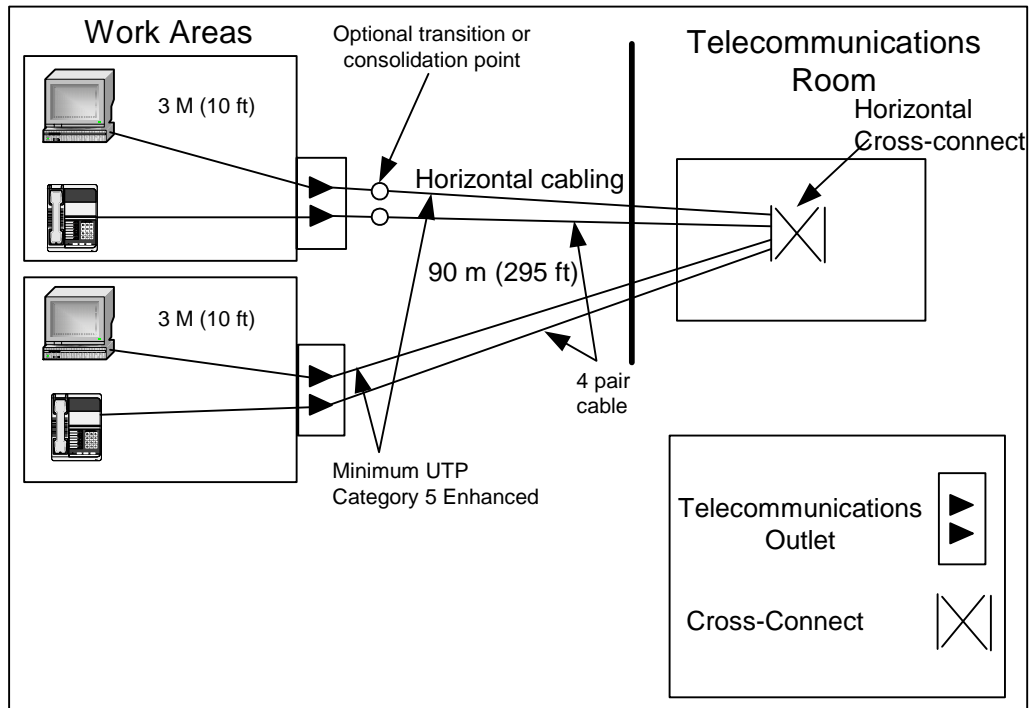


Figure 3 Horizontal Cabling Schematic

### 4.3.2 Location and Spacing:

Outlets should be located to provide connectivity to every workspace location. If workspace locations have not been determined, then outlets should be provided for every 100 square feet of usable workspace. Each conference room should be provided with at least one outlet. A power failure telephone outlet shall be placed at the location of the main answering position. Consideration should be given to spaces that may be eventually used as work spaces and outlets provided accordingly. Outlets shall be mounted 18" above the finished floor.

### 4.3.3 Acceptable cables:

Unshielded Twisted Pair - Category 5e, Category 6 (TIA / EIA-568-B) or higher  
Unshielded Twisted Pair - TIA / EIA 568-B, -CMR or CMP NEC Rating.

50/125 Micrometers Laser Optimized Class 1a Graded Index - OFNR or OFNP  
NEC Rating (Fiber  
Distributed Data Interface - FDDI compatible).

62.5/125 Micrometers Class 1a Graded Index - OFNR or OFNP NEC Rating  
(Fiber Distributed Data Interface - FDDI compatible).

### 4.3.4 Electrical Service:

A minimum of three duplex 120 Volt AC power outlets shall be provided for each workspace location or private office and fused at 20 amperes.

## 5.0 TELECOMMUNICATIONS ROOMS

The telecommunications room shall be located as close as practicable to the center of the area served and preferably in the core area. The telecommunications room space shall be dedicated to the telecommunications function and related support facilities. Telecommunications closet space should not be shared with electrical installations other than those for telecommunications equipment. This document assumes the shared use of the telecommunications needs of all occupants of the area served.

NOTE: All telecommunications backboards shall be void free and fire-retardant or treated on all six sides with at least two coats of fire retardant paint. **If fire retardant paint is used, plywood shall be repainted on all 6 sides at manufacturer specified intervals.**

### 5.1 Riser Rooms:

In multi-story buildings, rooms shall be centrally located and stacked, when practicable. Rooms are placed directly above each other with riser pathways between them.

### 5.2 Size:

Equipment rooms and telecommunications rooms must be large enough to house equipment, controllers, equipment racks, fiber optic equipment, and Service Provider lines.

Even if the customer does not anticipate any growth, the equipment room should include adequate space to support equipment changes with minimal disruption. There are likely to be many equipment changes during the useful life of any equipment room.

In addition to space for telecommunications equipment and cabling, an equipment room must include space for any environmental control equipment, power conditioners, and Uninterruptible Power Supply (UPS) systems that will be installed there.

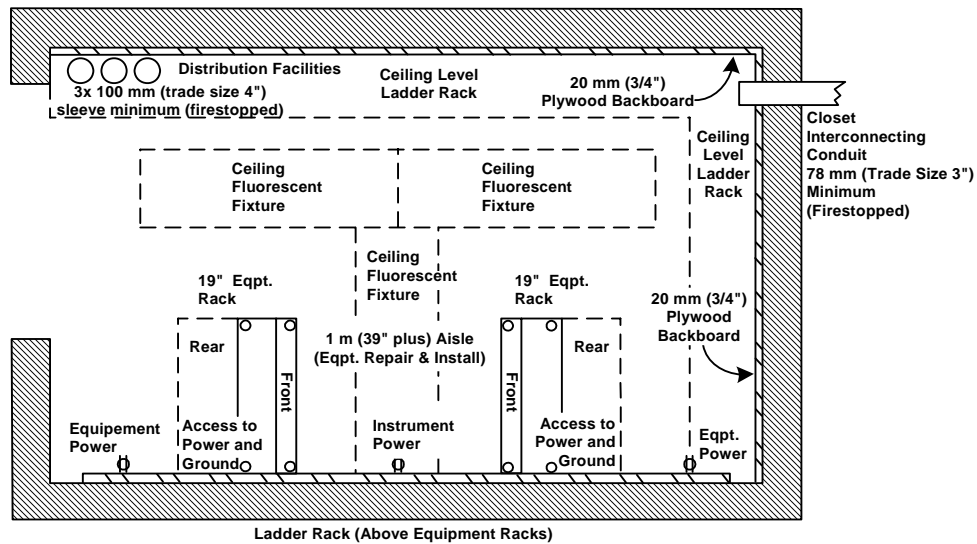
Special consideration to space should be given in the event a Local Area Network (LAN) now exists or will exist in the future. The minimum ceiling height is 8 ft 6 in. There shall be a minimum of one telecommunications room per floor. Additional rooms (one for each area up to 10,000 square feet) should be provided when:

- (1) The floor area to be served exceeds 10,000 square feet, or
- (2) The horizontal distribution distance to the workstation exceeds 90 meters (295 feet).

Based on square footage served, telecommunications rooms shall be minimally sized according to the table below:

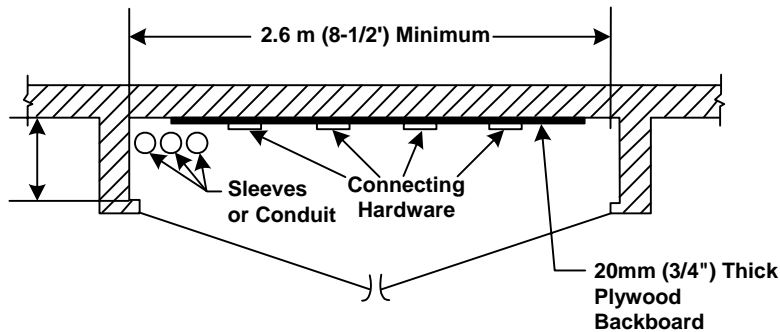
<u>Serving Area</u> Square Feet	<u>Room Size</u>
10,000	10' x 11'
8,000	9' x 10'
5,000	7' x 10'

## Layout of Telecommunications Closet



**Telecommunications room doors should always swing to the outside!**

**Figure 4 Typical Telecommunications Room**



**Figure 5 Typical Shallow Telecommunications Closet**

### 5.3 A C Power Outlets:

A minimum of two dedicated 20 A, 120 V AC duplex electrical outlets, each on separate circuits, shall be provided for equipment power. In addition, convenience duplex outlets shall be placed at 6 feet intervals around the perimeter walls, at a height of 6 inches above the floor. If emergency power is available, consideration shall be given to automatic switchover of power. Specific outlets for equipment and convenience along with their locations shall be coordinated with the telecommunications system designer/s.

### 5.4 Wall Space and Layout:

Wall space should be provided that is adequate for termination of cables and equipment including equipment racks with access to the complete riser cable. Figure 4 and Figure 5 show typical telecommunications room layouts. The preferred equipment rack will be a floor mounted 7' high rack with horizontal supports connected to the wall at the upper 1/3 of the rack with clearance of 36" on all sides unless multiple racks are mounted side by side with cable management adjacent. A single wall mounted equipment rack is acceptable for a small installation where growth is not anticipated.



#### **5.4.1 Equipment Layout within Rack:**

Passive equipment (e.g., patch panels) shall be located in top of equipment rack with active equipment (e.g., switches, concentrators, hubs, multiplexers, routers) located in lower section. Any rack-mounted ac power bars should be located in the very bottom of the equipment rack. Equipment racks shall be fitted in front, sides and rear with cable management components such as wireminders of sufficient quantity for a neat and clean installation. Patch cables shall be arranged in a manner that will cause minimal disruption when changes are necessary. Equipment racks shall be mounted so as to leave 36 inches of clearance to wall from any piece of equipment protruding from the front or back of rack.

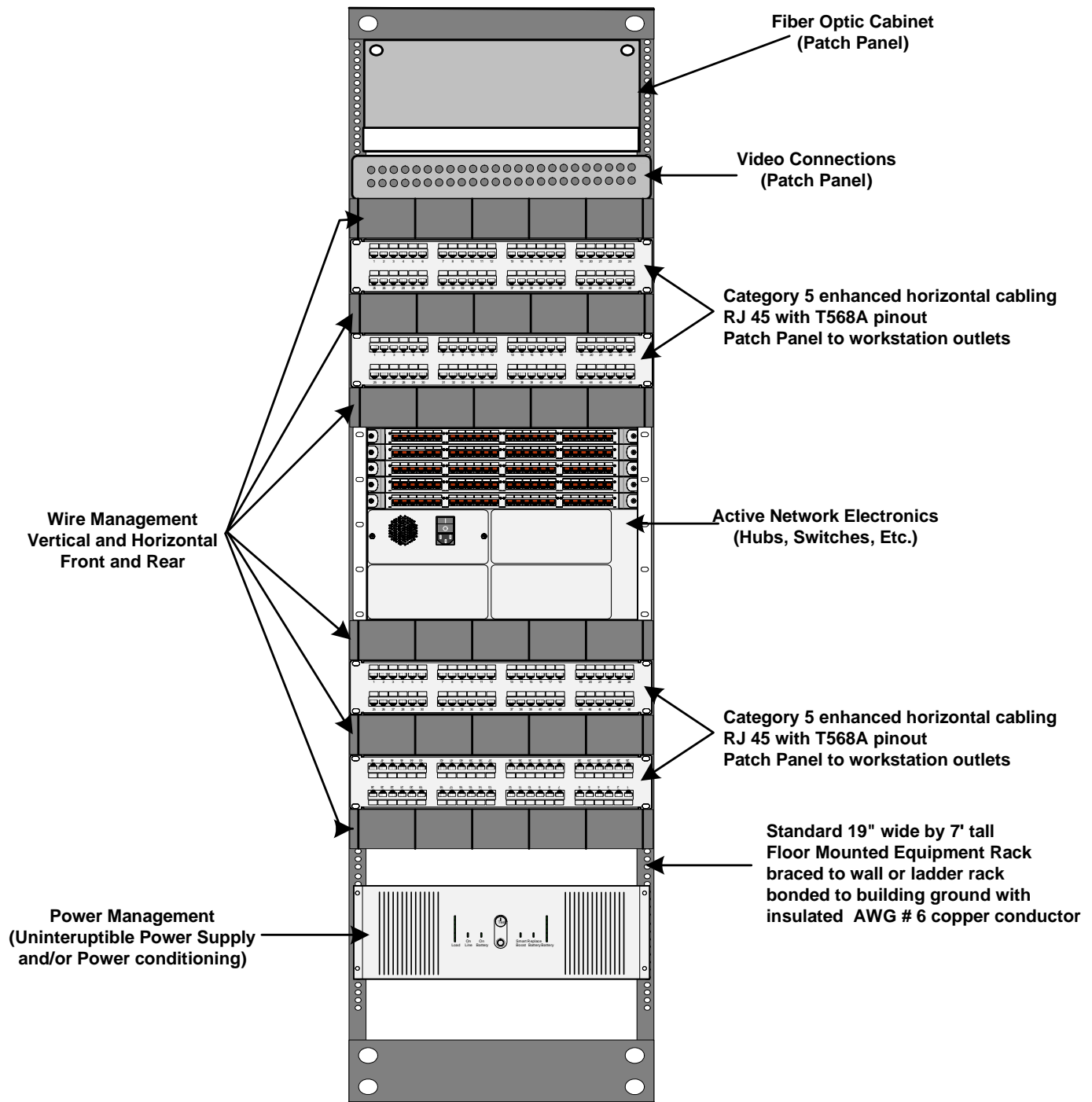
#### **5.5 Cross Connect Field:**

Non IP termination blocks shall be mounted on 4' X 8' sheets of 3/4" fire retardant plywood. The intermediate voice distribution frames located in the telecommunications rooms consist of plywood-mounted, quiet-front Krone type IDC blocks or 110 type cross connect blocks that terminate the interframe backbone and the horizontal distribution system.

Intermediate distribution frame blocks installed in racks should be divided into sections with the top section for fiber and copper patch panels and the bottom section for active electronics. Interframe backbone blocks will always appear closest to the backbone cable. Station blocks that terminate the horizontal distribution system wires should appear farthest from the backbone. All in-use blocks should be clearly labeled. Regardless of the block type used, the number of twists must be maintained all the way to the punch down.

110 type IDC connecting clips should be installed for every installed cable pair.

Patch cable type #110P connecting blocks may be used at some locations and punch down type #110A connecting blocks at other locations depending on frequency of change and expertise of personnel that perform cross connectivity. Access clearance for front and sides of equipment racks or backboard shall be 3 feet beyond any mounted items.



**Figure 6 Data Distribution Frame Layouts**

## 6.0 BACKBONE CABLING

### 6.1 Riser Design:

The riser connects telecommunications rooms with the common equipment providing a high capacity riser cable. Fiber should be used in data backbone and specific voice and video application backbone unless there is a strong business case for not doing so. Risers consist of a minimum of 6-strand multimode fiber optic cable in high-rise buildings and in any other buildings where the distance is greater than 295 feet.

For locations that do not anticipate the use of optical fiber, Unshielded Twisted Pair (UTP) riser cable should be sized to accommodate 50 percent growth over the number of initially installed dual 4 pair workstations. Even if no fiber is installed initially, the pathways of conduit and duct should allow room for the later addition of fiber.

### 6.2 Acceptable cables:

All Categories of cabling shall meet the TIA / EIA 568-B and 598 standard.  
Inside plant fiber cable shall comply with ANSI / ICEA S-83-596.  
Outside Plant fiber cable shall comply with ANSI / ICEA S-87-640.

#### Voice & Data:

Unshielded Twisted Pair – 100 ohm Category 5e Data Grade with transmission characteristics specified to a minimum of 100 MHz, CMR or CMP NEC Rating.

Unshielded Twisted Pair – 100 ohm Category 6 Data Grade with transmission characteristics specified to a minimum of 250 MHz, CMR or CMP NEC Rating.

50/125  $\mu\text{m}$  Class Ia Graded Index Multimode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating.

62.5/125  $\mu\text{m}$  Class Ia Graded Index Multimode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating.

8.3/125  $\mu\text{m}$  Class IVa Dispersion-Unshifted Single-mode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating.

#### Video:

\* RG-11 and RG-6 broadband (75 ohm) Coaxial Cable, CL2 or CL2P NEC Rating

\* UTP has proven to be capable of transmitting high quality video signals for certain applications by use of a commercially available video adapter. Products supporting true broadband (multiple channels) color signals on UTP are available. Coaxial Cables and Singlemode Fiber Optic Cables remain the media of choice for long distance video transmission and for backbone video feeder systems.

**Note: ITS only recommends the use of polyethylene sheathed or interlocking armored cable for all “Outside Plant” applications.**

## 7.0 ENTRANCE FACILITY

### **7.1 National Electrical Code Adherence:**

All telephone communications circuits shall be installed in accordance with the latest published version of Article 800 of the National Electrical Code.

**Exception:** The "Protective Devices" requirements of paragraph 800-2 are to apply to all outside circuits of any length whether aerial or underground. All arrestors shall be solid-state type, tested and listed per ANSI/UL 497 1995 or later. They shall be installed on each telephone circuit entering a building as close as practicable to the point of entry.

### **7.2 Protectors:**

All protectors shall be grounded using AWG 12 (minimum) copper wire for single line or double line, AWG 10 for three through six lines, and AWG 6 for seven or more lines. This conductor shall be connected to the building's Grounding Electrode System described by NEC 250-81 in accordance with NEC 800-31 (b) 5. The primary protector shall be 189B1 with AT&T 3C1SC equivalent protector units (solid state type).

### **7.3 Grounding:**

TIA / EIA 607 covers requirements for telecommunications grounding and bonding as a system. The major guidelines are as follows:

- A permanent infrastructure for telecommunications grounding and bonding is specified to be independent of telecommunications cabling.
- Telecommunications bonding connections are always implemented in accessible locations with approved components.
- Minimum #6 AWG insulated copper bonding conductors (Telecommunications Bonding Backbone [TBB]) are installed through every major telecommunications pathway (backbone pathway) and directly bonded to a telecommunications grounding busbar (TGB) in each telecommunications equipment location.
- A Telecommunications Main Grounding Busbar (TMGB) is directly bonded to the electrical service ground. All TBBs end on this busbar.
- Generally, each TBB should be a continuous conductor from the TMGB to the farthest TGB. Intermediate TGBs should be bond connected to the TBB with a short bonding conductor.

The increasing need for the reliable transfer of massive amounts of information creates an environment where electrical protection takes highest priority. The main consideration in developing requirements for grounding, bonding, and electrical protection is safeguarding of personnel, property and equipment from the potential harm created by foreign electrical voltages and currents.

The protection of telecommunications facilities is an essential part of any distribution system. The National Electrical Code defines grounding and bonding parameters for telecommunications from the aspect of human safety. NEC Articles 250 and 800 cover the general requirements for grounding, bonding, and protecting electrical and

telecommunications circuits. NEC requirements are considered the minimum for safeguarding personnel and equipment.

It is the state standard that telecommunications systems be isolated to the building ground. Neutral ground current problems are so severe in some modern buildings that telecommunications systems fail to work. Equipment manufacturers' grounding and bonding instructions shall be closely adhered to.

Multi-line cable with separate shield is to be grounded per "7.2" above, where it enters any building, but by separate conductor. The cable shield is to be removed for a length of at least 12 inches on the equipment side of this ground connection, or non-shielded cable used from this point to the equipment.

The telecommunications equipment is to be Single Point Grounded (SPG). This single point ground consists of bonding together, at one point, the station equipment grounding connection, the green power wire, the inside cable shield (if any), and the station protector grounding conductors.

#### **7.4 Surge Protectors:**

The AC power circuit that feeds telecommunications equipment (cabinets, key switches, PCs, any and all peripheral equipment including digital announcers and music on hold devices) shall be provided with a surge protector. No equipment other than related peripherals shall be connected to this circuit.

#### **7.5 Sneak Current Fuses:**

Certain station equipment (usually with circuits of 100 OHM or less impedance to ground) may require secondary protection also referred to as "Sneak Current Fuses" to prevent equipment failure, line hazard, and danger to personnel. The vendor providing the devices that require secondary protection shall install secondary protection.

#### **7.6 Entrance Conduit:**

Sizes: Entrance conduit size will vary with number of cable pairs entering building, but the absolute minimum shall be two 2-inch conduits. Buildings larger than 10,000 square feet shall have at least three 4-inch conduits. Riser sleeves or conduit shall be at least three inches. (Provisions may be made for non-continuous sleeves for riser rather than conduit). Conduit for horizontal service from floor equipment rooms to jack locations shall be 3/4 inch or greater depending upon expected number of cables and planned growth. Planned capacity should be for 100% redundancy.

Entrance conduit shall extend from entrance (termination) room beyond any paved areas. All exposed portions of "Outside Plant" conduit shall be minimum schedule 80 PVC or rigid steel to a depth of not less than 24-inches below final finished grade.

Location: Elevator shafts shall be excluded for possible locations of any conduit.

#### **7.7 Innerduct:**

A sleeved physical channel shall be provided for fiber optic cable unless interlocking armored cable is deployed. This is to be within the conduit system, unless the "innerduct" is plenum rated. Above ceiling innerduct not encased in a conduit must be

UL Approved and bear designations stating so. Innerduct shall contain a pull string if no fiber is pulled at the time of the installation of innerduct.

## **8.0 CAMPUS DESIGN**

This section is intended as a typical campus distribution structure. This type of distribution occurs primarily on state governmental, university and community college campuses, but can be used to interconnect buildings anywhere a number of buildings are functionally collocated with property rights of way.

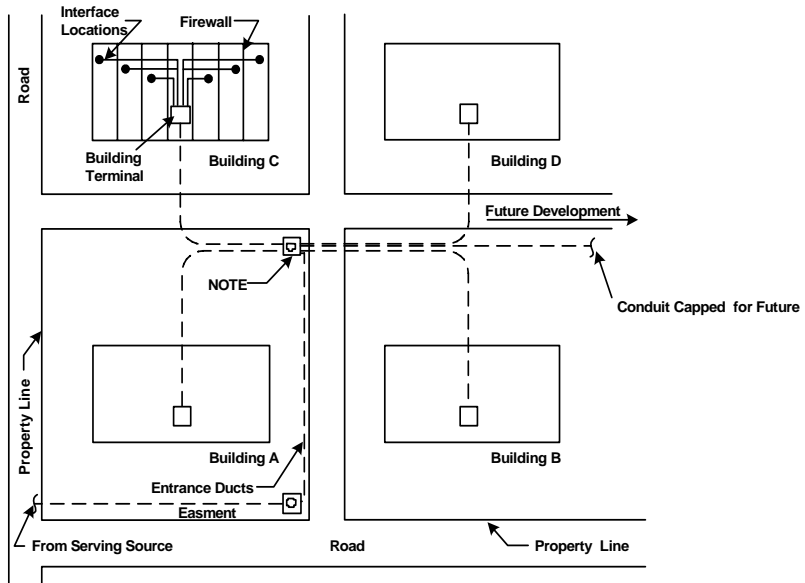
Figure 7 shows a four building campus. The Service Provider (local telephone company) enters the property and continues cabling to Building A. The SP terminates connections on plywood-mounted 110-type cross connect blocks in the Entrance Facility. This is the demarcation point and the owner / agency is responsible for wiring beyond this point. It is the responsibility of the property owner to provide the pathway from the property line to the entrance facility.

The Main Cross-connect is the focal point for interbuilding communications. There is one Main Cross-connect where the Service Provider and outside facility cabling is terminated. Cables are then distributed to other floors and to other buildings. The Main Cross-connect should be centrally located.

A campus distribution system can be viewed as a common communications network, but each building should be treated individually for basic wiring considerations of:

- Bonding
- Grounding
- Electrical Protection
- Building codes and regulations
- Fire stopping.

Interbuilding cables should consist of optical glass fiber of not less than twelve (12) multimode fibers plus six (6) single mode fibers. Fiber cables should be in innerduct inside conduit.



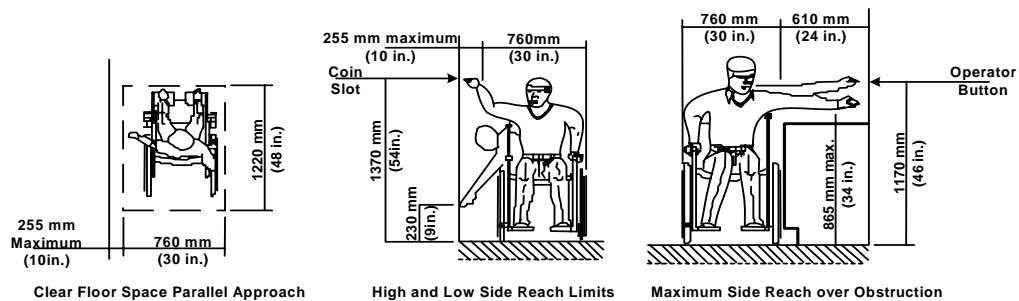
**Figure 7 Typical Campus Wiring System**

## 9.0 HANDICAP AND OTHER SPECIAL REQUIREMENTS

### 9.1 Handicap Requirements:

Compliance with The Americans With Disabilities Act (ADA) (36CFR Part 1191) shall be maintained at all times. This act specifies text control telephones and volume control telephones be provided along with signage wherever banks of pay phones are installed. It also details mounting heights and clearances for telephones.

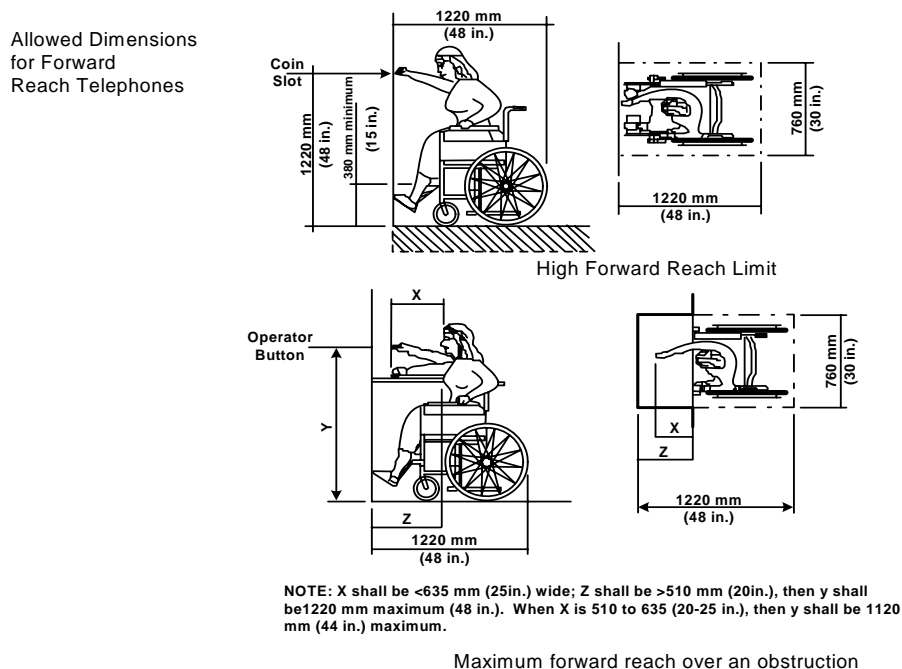
#### Allowed Dimensions for Side Reach Telephones



**NOTE:**

The minimum height for all electrical and communications systems receptacles on walls (i.e., outlets, and jacks) must be 380 mm (15 in.) above finished floor.

**Figure 8 ADA Mounting Heights & Clearances For Side Reach**



**Figure 9 ADA Mounting Heights & Clearances For Forward Reach**



All "banks" of public telephones shall have at least one telephone, which can be used by physically disabled, including those in wheel chairs and those with hearing and sight disabilities. The following are minimum requirements:

A clear floor or ground space at least 30" by 48" that allows either a forward or parallel approach by a person using a wheelchair shall be provided at telephones. Bases, enclosures, and fixed seats shall not impede approaches to telephones by people who use wheelchairs. The highest operable mechanism shall be placed no more than 48 inches above the floor for forward reach telephones and 54 inches above the floor for side reach telephones. If side reach occurs over an obstruction 24 inches wide and 34 inches high, the maximum height allowed is 46 inches.

The telephone shall be hearing aid compatible with volume control capable of a minimum of 12dbA and a maximum of 18dbA above normal for the handset with instructions for use. If an automatic reset is provided then 18dbA may be exceeded.

Text telephones used with a pay telephone shall be permanently affixed within, or adjacent to, the telephone enclosure. If an acoustic coupler is used, the telephone cord shall be sufficiently long to allow connection of the text telephone and the telephone receiver.

Pay telephones designed to accommodate a portable text telephone shall be equipped with a shelf and an electrical outlet within or adjacent to the telephone enclosure. The telephone handset shall be capable of being placed flush on the surface of the shelf. The shelf shall be capable of accommodating a text telephone and shall have 6" minimum vertical clearance in the area where the text telephone is to be placed.

The telephone shall be equipped for those with sight disabilities with visual and tactile instructions for use. Large tactile letters shall be used for instructions. On every floor where telephones are installed, at least one should be placed so that the dial and handset are no more than 4 feet above the floor, equipped for those with hearing and sight disabilities and so identified with visual and tactile instructions for use.

Controls and operating mechanisms shall be operable by a force of five pounds or less; operation shall not require the use of a fine grasp, tight pinching motion or a turning, wrist-twisting motion for activation.

## **9.2 Elevator Requirements:**

Emergency two-way communication systems between the elevator and a point outside the hoist way shall be provided. The highest operable part of a two-way communication system shall be a maximum of 48" from the floor of the car. If the system uses a handset then the length of the cord from the panel to the handset shall be at least 29". The emergency intercommunication system shall not require voice communication (e.g., autodial to enunciator with location identification).

**9.2.1 Elevator Telephone:**

A single line wall telephone set shall be installed in each elevator in a telephone box supplied by the company installing the elevator.

**9.2.2 Elevator Wiring:**

The telephone for each elevator shall be wired so it is independent of the telephone system in the rest of the building. A separate line is required for each elevator.

**9.2.3 Dial Tone:**

The telephone system in each elevator shall have dial tone in order to pass inspection.

**9.2.4 Elevator Conduit:**

A three-quarter-inch conduit should be placed between the elevator control room and the nearest telecommunications room.

**9.2.5 Backboard:**

A one-half inch backboard should be glued to the inside rear wall of the telephone box in the elevator.

**9.3 Code Compliance:**

All wiring shall comply with Article 800 of the National Electrical Code, the American National Standards Institute and the National Electric Safety Code (NEC) and shall be subject to acceptance tests as described in FCC Rules and Regulations, Title 47, Section 28.215, Chapter 1, Part 68. The primary application of these guidelines for communications is directed to (a) protective devices and methods for "exposed" cable and wiring, (b) separation of power circuits, and (c) fire stopping and special fire resistant and low-smoke producing cable in specified environments. All new cable and wire installed in air plenums and ducts shall be flame resistant and have low smoke properties in accordance with Article 800-3 (d) of the \*latest published version of the National Electrical Code and shall be so classified by Underwriters Laboratories, Inc. All cable installed in steam tunnels must be able to withstand temperatures of 125 degrees centigrade.

\* The NEC is revised every three years.

## 10.0 ADMINISTRATION

- TIA / EIA 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings is incorporated by reference. Compliance shall be maintained.
- Each pathway (conduit, tray, raceway, etc.) that conveys telecommunications media from space to space shall be given a unique identifier and labeled at each end-point.
- Each telecommunications space (equipment room, telecommunications room, work area, entrance facility, manhole and handhole) shall be uniquely identified and labeled.
- Each cable shall be uniquely identified and labeled at each end.
- Each cable record must indicate the cable type by manufacturer and manufacturer's designation, and document every pair/conductor in the cable. Cable identifier must be linked to all pathways in which it runs.
- Each piece of termination hardware such as a patch panel or wiring block shall be uniquely named and labeled.
- Termination position on cross-connect shall be identified by type, the pair / conductor terminated and a user code.

### 10.2 Labeling:

Each work area shall be labeled with a unique identifying number. A consistent labeling and numbering scheme shall be used. The labeling shall be clearly legible on the outlet face and the termination end. The numbering plan shall identify the source and destination of the cable for horizontal runs.

A sample numbering plan is: 208A-A1/241B

Where 208 is the telecommunications room #:

"A" is the patch panel identification,

"A1" is the "A" Block and the first position,

"241" is the workstation room #,

And "B" is the workspace of the user in room 241.

Horizontal cable shall be labeled at the workstation end and the cross-connect end. Backbone cables (whether riser or horizontal) shall have an identifying number that is labeled at each end. Labels shall be the same color on each end. Performance documentation must use the same labeling scheme.

### 10.3 Cable Tracking:

To support future expansion, reconfiguration and maintenance, complete records of all system characteristics should be developed and maintained. On each element in the route, identification labels should be completed and attached. Labels should meet the requirements of UL 969 Standard for Marking and Labeling Systems. A Final Report should record system configuration, unique identifier, fiber labels, pathways and "as built" details. The mandatory elements of Figure 10 must all be included. Loss measurements and OTDR traces should also be included with the records.

As a part of any cable installation, records of the connections are required. Changes to wiring should be maintained and accurate records made available at all times. A physical inventory should be performed on a periodic basis.

Tracking can be done manually, with a computer-based system or both. It is recommended that any installation having 200 or more devices (telephones, PCs, terminals, printers, LAN devices, plotters, etc.) pursue a computer-based system. There are reasonably priced systems available that can be implemented compliant to the TIA / EIA-606 standard this document references.

For major renovations or extensive additions, records are required. Existing buildings shall have records modified as moves, adds and changes (MACs) are done in the building. Work orders for wiring changes should be retained with other records for backup and research reasons.

### 10.4 Color Coding:

<u>TERMINATION TYPE</u>	<u>COLOR</u>	<u>COMMENTS</u>
Demarcation Point	Orange	Central Office Terminations
Network Connections	Green	Network connections or auxiliary circuits
Common Equipment, PBX, host, LANs, Muxes	Purple	Used for all major switching & data terminations
1st Level Backbone	White	Main cross-connect to
2nd Level Backbone	Gray	Intermediate cross-connect to telecommunications room
Station	Blue	Horizontal cable terminations
Interbuilding	Brown	Campus cable terminations
Key systems	Red	Key Telephone Systems
Miscellaneous	Yellow	Auxiliary, maintenance alarms, security

### 10.5 Records:

Figure 10 shows a summary of required records and linkages. Figures 11 - 14 are examples of what results from these requirements. Following these guidelines will provide detailed information that can save many labor hours in trouble shooting and planning.

	<b>RECORD</b>	<b>REQUIRED INFORMATION</b>	<b>REQUIRED LINKAGES</b>
<b>PATHWAYS &amp; SPACES</b>	<b>PATHWAY</b>	Pathway identifier Pathway type Pathway fill Pathway loading	Cable records Space records Pathway records Grounding records
	<b>SPACE</b>	Space identifier Space type	Pathway records Cable records Grounding records
<b>WIRING</b>	<b>CABLE</b>	Cable identifier Cable type Unterminated. Pair / conductor numbers. Damaged pair / conductor numbers. Available pair/cond. numbers.	Termination position records Splice records Pathway records Grounding records
	<b>TERMINATION HARDWARE</b>	Term. hardware identifier Term. hardware type Damaged position nos.	Termination position records Space Records Grounding records
	<b>TERMINATION POSITION</b>	Term. hardware identifier Term. position type User code Cable pair/cond. nos.	Cable records Other term. position records Termination hardware records Space records
	<b>SPLICE</b>	Splice identifier Splice type	Cable records Space records
<b>GROUNDING BONDING</b>	<b>TMGB</b>	TMGB identifier Busbar type Grounding conductor identifier Resistance to earth Date measurement taken	Bonding conductor records Space records
	<b>BONDING CONDUCTOR</b>	Bonding conductor identifier Conductor type Busbar identifier	Grounding busbar records pathway records
	<b>Telecommunications Grounding Bar</b>	Busbar identifier Busbar type	Bonding conductor records Space records

**Figure 10 Summary of Record Elements**

	SAMPLE DATA
<b>REQUIRED INFORMATION</b>	
<b>Pathway identifier</b>	<b>CD34</b>
<b>Pathway type</b>	<b>2 in. EMT</b>
<b>Pathway fill</b>	<b>20%</b>
<b>Pathway loading</b>	<b>n/a</b>
<b>REQUIRED LINKAGES</b>	
<b>Cable records</b>	<b>C0001, C0002</b>
<b>Space record (end 1)</b>	<b>D306</b>
<b>Space record (end 2)</b>	<b>3A</b>
<b>Space records (access)</b>	
<b>Pathway records (other)</b>	<b>n/a</b>
<b>Grounding record</b>	<b>n/a</b>
<b>OPTIONAL INFORMATION</b>	
<b>Pathway length</b>	<b>132 ft</b>
<b>Pathway max. fill</b>	<b>40%</b>
<b>Pathway max. load</b>	<b>n/a</b>
<b>Pathway condition</b>	<b>ok</b>
<b>Pathway usage</b>	<b>horizontal distribution</b>
<b>Number of bends</b>	<b>2</b>
<b>Drawing number</b>	<b>C3</b>
<b>UPC</b>	<b>n/a</b>
<b>Misc. information</b>	
<b>OTHER LINKAGES</b>	
<b>Other record 1</b>	<b>B35</b>
<b>Other record 2</b>	

Figure 11 Example of a Single Pathway Record for a conduit

	SAMPLE DATA
<b>REQUIRED INFORMATION</b>	
<b>Space Identifier</b>	<b>3A</b>
<b>Space type</b>	<b>TC</b>
<b>REQUIRED LINKAGES</b>	
<b>Pathway Records</b>	<b>CD34, CT64, SL02-05, CD02</b>
<b>Cable records</b>	<b>C0001, C0011, CB02</b>
<b>Grounding record</b>	<b>TGB35</b>
<b>OPTIONAL INFORMATION</b>	
<b>Space size</b>	<b>10 ft x 11 ft</b>
<b>Space locations</b>	<b>3-A4</b>
<b>Area serviced</b>	<b>Q-4</b>
<b>Door lock key number</b>	<b>1425</b>
<b>Misc. Information</b>	
<b>OTHER LINKAGES</b>	
<b>Other record 1</b>	<b>E34</b>
<b>Other record 2</b>	<b>AC304</b>
<b>Other record 3</b>	<b>AU1</b>
<b>Other record 4</b>	

Figure 12 Example of a Single Space Record for a telecommunications closet

	SAMPLE DATA
REQUIRED INFORMATION	
<b>Space identifier</b>	<b>D306</b>
<b>Space type</b>	<b>W A</b>
REQUIRED LINKAGES	
<b>Pathway records</b>	<b>CD34</b>
<b>Cable records</b>	<b>C0001</b>
<b>Grounding record</b>	<b>n/a</b>
OPTIONAL INFORMATION	
<b>Space size</b>	<b>10 ft x 12 ft</b>
<b>Space location</b>	<b>n/a</b>
<b>Area served</b>	<b>n/a</b>
<b>Door lock key number</b>	<b>n/a</b>
<b>Misc. Information</b>	
OTHER LINKAGES	
<b>Other record 1</b>	<b>PC569</b>
<b>Other record 2</b>	<b>TR3</b>
<b>Other record 3</b>	<b>Smith, John</b>
<b>Other record 4</b>	

Figure 13 Example of a Space Record for a work area



SAMPLE DATA		
<b>REQUIRED INFORMATION</b>		
<b>Cable identifier</b>	<b>C0011</b>	
<b>Cable type</b>	<b>4-pr. UTP, EIA-568A spec.</b>	
<b>Unterminated pair conductor numbers</b>	<b>0</b>	
<b>REQUIRED LINKAGES</b>		
	<b>End 1</b>	<b>End 2</b>
<b>Pr 1-4, Term. pos. record</b>	<b>J00011</b>	<b>3A-C17-005</b>
<b>Splice records</b>	<b>n/a</b>	
<b>Pathway records</b>	<b>CT64</b>	
<b>Grounding record</b>	<b>n/a</b>	
<b>OPTIONAL INFORMATION</b>		
<b>Cable length</b>	<b>165 ft</b>	
<b>UPC</b>	<b>n/a</b>	
<b>Ownership</b>	<b>n/a</b>	
<b>Misc. information</b>		
<b>OTHER LINKAGES</b>		
<b>Other record 1</b>		

**Figure 14 Example of a Cable Record for a horizontal UTP cable**

## 11.0 TESTING:

All test data shall be documented and provided to the purchasing agency at the time of acceptance.

### 11.1 Multipair UTP Feeder Testing:

All cable pairs shall be tested for the following conditions:

1. Polarity
2. Reversal of pairs
3. Wire transpositions
4. Continuity
5. Opens
6. Shorts

### 11.2 UTP Category 5e and Category 6 Testing Parameters

The current field acceptance test parameters for twisted-pair cabling are:

- Wire Map (continuity)
- Insertion Loss
- Length
- NEXT loss, pair-to-pair, measured from local end
- NEXT loss, pair-to-pair, measured from far-end
- NEXT loss, power sum, measured from local end
- NEXT loss, power sum, measured from far-end
- ELFEXT, pair-to-pair
- ELFEXT, power sum
- Return loss, measured from local end
- Return loss, measured from far-end
- Propagation delay
- Delay skew
- ACR
- Power Sum (PSACR).

NOTE: The above parameters will also apply to Class D and higher as specified in ISO / IEC 11801.

### 11.3 Fiber Optic Testing:

#### SYSTEM TESTING

Optical fiber splices, fusion or mechanical, shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI / EIA / TIA- 455-34, Method A (factory testing) or ANSI / EIA / TIA-455-59 (field testing).

Optical fiber splices, fusion or mechanical, shall have a minimum return loss of 20 dB for multimode, 26 dB for singlemode, when measured in accordance with ANSI / EIA / TIA-455-107. The minimum singlemode return loss for broadband analog video (CATV) applications is 55dB.

Upon completion of the passive optical cable system, the system must be tested to ensure compliance with the design and link loss specifications.

The single most important test is end-to-end attenuation test that measures the optical power loss between cable termination points. The attenuation of a system at one wavelength is not necessarily related to the attenuation at the other, except for short links such as horizontal cabling. The best way to verify the cabling meets the loss limit is to measure each segment between patch panels. Because of the stress and bending that cables undergo during installation, measurement of the attenuation of each link with connectors in place is required after installation.

The tests include:

Power meter tests - For building risers, power meter tests are required. Disregard OTDR testing for runs less than 2 km.

Testing of End-to-End Attenuation on each fiber span at both operational wavelengths:

- 850 / 1310 nm for multimode fiber
- 1550 nm for single mode fiber

Testing in one direction is required. Test results shall be retained for inclusion into the documentation package. Link attenuation does not include any active devices or passive devices other than cable, connectors and splices (e.g., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers).

Connector loss readings of each mated connector should be recorded using an OTDR at 850 nm and 1310 nm in one direction.

Optical Time Domain Reflectometer (OTDR) Signature Traces of each terminated fiber should be recorded at 850 nm and 1310 nm for fiber continuity purposes. OTDR testing is mandatory for runs longer than 2 KM.

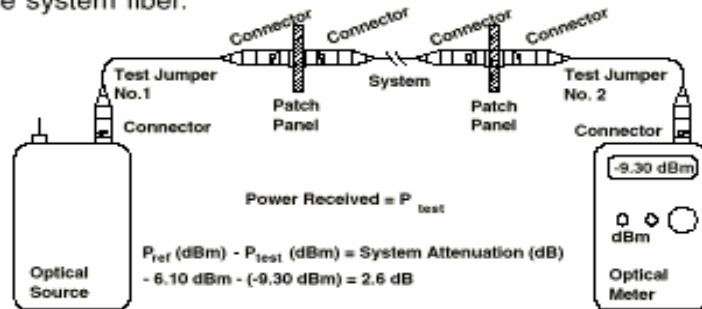
A Final Report shall be compiled that records system configuration, fiber labels, cable routes and "as built" details. Loss measurements with calibrated light source and power meter shall be included. OTDR traces shall also be included when requested in advance.

Leave the jumpers attached to the optical source and optical power meter.

Disconnect the two jumpers at the adapter.

Attach the optical source/Test Jumper 1 to one end of the system fiber to be tested.

Attach the optical power meter/Test Jumper 2 to the other end of the system fiber.



Record the test power ( $P_{test}$ ).

Subtract the test power ( $P_{test}$ ) from the reference power ( $P_{ref}$ ) recorded in Stage 1 to determine the end-to-end attenuation:

$$\text{Attenuation (dB)} = P_{ref} - P_{test}$$

Figure 15 Fiber Link Test Setup

## GLOSSARY

**ADMINISTRATION** - The process of documenting the initial wiring and management of the wiring system after the initial installation. It includes two major components: a standard labeling system and a records system.

**AMERICAN WIRE GAGE (AWG)** - An American industrial standard for measuring the diameter of copper, aluminum and other conductors; e.g. AWG #22 is a 0.64 millimeter (0.0253 inches) diameter solid conductor and AWG #24 is a 0.5 millimeter (0.0201 inches) diameter solid conductor.

**ANSI** - American National Standards Institute.

**BUILDING MAIN DISTRIBUTION FRAME (MDF)** – Old term removed from standards language but left in this document for reference. The interface between the public network and/or the interbuilding backbone, and the interframe backbone.

The MDF is usually in the Entrance Room (ER) or Main Telecommunications Room (MTR).

**EIA** - Electronics Industries Alliance.

**ENTRANCE FACILITY (EF)** - Facility where outside circuits/wiring enter a building through weatherproof sleeves and are terminated on blocks providing electronic protection to guard against damage from electrical disturbances such as lightning. In a single building, this is the point of demarcation between the serving telephone utility and the user.

**EQUIPMENT ROOM** - An area within a building where major components of large telecommunications systems (PBX's, data switches and communications processors) are housed. Equipment rooms are often distinct from telecommunications closets due to the size and quantity of the equipment they contain.

**HORIZONTAL DISTRIBUTION SYSTEM (HDS)** - The wiring that connects the intermediate distribution frame in the telecommunications closet to the telecommunications outlet. Horizontal distribution cabling is commonly run through the space provided by drop-tile ceilings or routed through ducts in floors and walls.

**IEEE** – The Institute of Electrical and Electronics Engineers, Inc.

**IEEE 10 Gb/s Ethernet over copper – Category 6e / Class e Cabling – Only ratified by IEEE at the time of publication of this document.** Category 6e / class e standards describe a new performance range for unshielded and screened twisted-pair cabling. Category 6 / class e is intended to specify the best performance that UTP and STP cabling solutions can be designed to deliver. Category 6 / class e is specified in the frequency range of at least 1 - 500 MHz. For Category 6 / class e, the 8-position modular jack interface will be mandatory at the work area. Category 6 / class e will be backward compatible which means that applications running on lower categories / classes will also be supported. If different category / class components are to be mixed with Category 6 / class E components, the combination shall meet the transmission requirements of the lowest performing category / class component. TIA, CENELEC, ISO, and others have collaborated closely on the development of these standards and their requirements are very much in harmony.

**INTERBUILDING BACKBONE** - The transmission facilities that connect the campus/complex main distribution frame to the building main distribution frames of each building in the complex. Includes multi-agency metropolitan areas with state right of way.

**INTERFRAME BACKBONE** - The transmission facilities that originate from the building main distribution frame and are vertically or horizontally distributed to each intermediate distribution frame in the building.

**INTERMEDIATE CROSS CONNECT** - Typically the equipment used to link the backbone and horizontal wiring systems. The intermediate cross connect is usually located in a telecommunications closet.

**LINKAGE** - A connection between a record and an identifier or between records.

**INTERMEDIATE DISTRIBUTION FRAME (IDF)** – Old term removed from standards language left in this document for reference. Replaced by Auxiliary Telecommunications Room. The cross connect between the interframe backbone (IFB) and the horizontal distribution system (HDS). The IDF may also serve as a connection point for per-floor Local Area Networking equipment. The IDF is normally in the Auxiliary Telecommunications Room (ATR).

**MAIN CROSS CONNECT** - Typically the equipment used to link the interbuilding and intrabuilding wiring systems. The main cross connect is usually located in the building entrance facility.

**NETWORK INTERFACE (NI)** - Contains the demarcation point between outside provider networks and the campus/complex or building distribution. Includes carrier test, loop back, and disconnect capability.

**MEGAHERTZ (MHz)** - Unit of frequency equal to one million cycles per second.

**NEC** - National Electrical Code.

**NEXT** - Near End Cross Talk - Signal distortion caused by the coupling of an outgoing signal at the originating end of a circuit with the incoming signal being received from the other end of the circuit

**NFPA** - National Fire Protection Association.

**OSHA** - Occupational Safety and Health Administration.

**PATCH CORD** - A length of wire, or fiber cable, with connectors on each end used to join telecommunications circuits.

**PATHWAY** - A raceway, sleeve, or exposed location for the placing of telecommunications cable.

**TELECOMMUNICATIONS ROOM (TR)** - The space in a building designed to provide a secure, suitable environment for the installation of cable, telecommunications equipment, and termination and administration systems. Telecommunications rooms are the points where the backbone and horizontal distribution facilities intersect. They are floor-serving rooms whose function is to terminate and connect the backbone cable system to the horizontal cable system and to house electronics that assist in the distribution of information to that floor.

**TELECOMMUNICATIONS INFRASTRUCTURE** - The components (telecommunications spaces, cable pathways, grounding, wiring and termination hardware) that together provide the basic support for the distribution of all telecommunications information.

**TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)** - Primary grounding for the entire telecommunications in a building or structure.

**TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)** - Auxiliary grounding for the telecommunications in a satellite telecommunications closet and tying into the telecommunications bonding backbone.

**TELECOMMUNICATIONS BONDING BACKBONE (TBB)** - A #6 AWG or larger insulated bonding conductor that provides direct bonding between different locations in a building.

**TIA** - Telecommunications Industries Association.

**UNSHIELDED TWISTED PAIR** - (UTP) wiring consisting of two insulated wires twisted around each other to reduce induction, thus interference, from one wire to the other. Twisted pair wire comes in bundles with varying numbers of pairs of wires, from two pair (four wires) to many thousands of pairs. UTP wiring is used to wire voice and data networks within buildings because it is relatively easy to install.

**STAR** - A network topology in which each telecommunications outlet is connected only to a distribution frame by a point-to-point link and connections between distributions frames are by point-to-point links.

**TELECOMMUNICATIONS OUTLET (TO)** - The interface between the building network (horizontal distribution system) and the work area connection to the user's equipment (phone and/or terminal device).

**WORK AREA CONNECTION** - The interface between the outlet and the user/terminal equipment. Includes media converters and media adapters, such as baluns and / or patch cords.

## **APPENDIX A: Recommended Cable Specifications**

This guideline recognizes the following type cables:

Fiber optic Multimode - Riser, Inter-building applications, and horizontal pathways

Fiber optic Singlemode - Inter-building applications, video applications

Unshielded Twisted Pair (UTP) - Category 5e, Category 6 and above (TIA / EIA 568-B)  
-Horizontal Distribution

### **Copper Data Cable Specification**

The standards recognizing the data handling characteristics of all twisted pair cable and connectors are the ANSI / TIA / EIA-568-B. Although other levels are specified in these standards, this specific guidelines document standardizes on a minimum standard of Category 5e for all voice and data telecommunications UTP horizontal wiring. Category 5e cable is intended for LAN speeds at 100 Megabits per second at a frequency up to 100 MHz. Category 6 cable is intended for LAN speeds at 1000 Megabits (1 Gigabit) per second at a frequency up to 250 MHz. Category 6 augmented cable is intended for LAN speeds at 10 Gigabits per second at a frequency up to 625 MHz.

**Note: ITS only recommends the use of polyethylene sheathed or interlocking armored cable for all “Outside Plant” applications.**

### **Multimode Fiber Specification**

Fiber type: 50/125 micron Laser Optimized Class 1a Graded Index Multimode, FDDI Compliant

Cladding Diameter:	125 Microns
Core Eccentricity:	7.5% maximum (1.5% typical)
Numerical aperture:	.275 plus or minus .015
Attenuation:	3.50 dB/km @ 850 NM 1.50 dB/km @ 1300 NM
Bandwidth:	500 MHz at 850 NM 500 MHz @ 1300 NM
Fiber connectors: SC type	.75 dB maximum insertion loss
Cable bend radius:	10 times diameter during installation



Fiber type: 62.5/125 micron Class 1a Graded Index Multimode, FDDI Compliant

Cladding Diameter:	125 Microns
Core Eccentricity:	7.5% maximum (1.5% typical)
Numerical aperture:	.275 plus or minus .015
Attenuation:	3.50 dB/km @ 850 NM 1.50 dB/km @ 1300 NM
Bandwidth:	160 MHz at 850 NM 500 MHz @ 1300 NM
Fiber connectors: SC type	.75 dB maximum insertion loss
Cable bend radius:	10 times diameter during installation

### **Single Mode Fiber Specifications**

Fiber type: 8.3 Micron Class Ia Dispersion-Unshifted Singlemode Optical Fibers

Cladding diameter:	125 Microns
Attenuation:	0.5 dB/km @ 1310 NM 0.5 dB/km @ 1550 NM

Zero dispersion wavelength 1300 -1320 NM

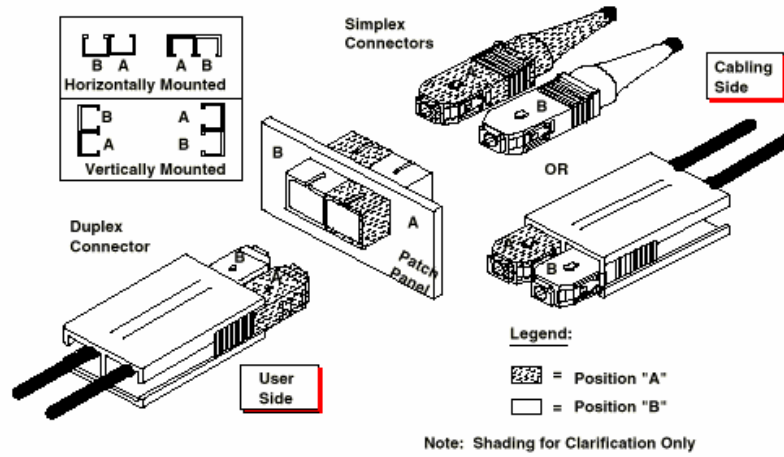
UL Ratings:	OFNR for riser usage OFNP for Plenum usage
Cable bend radius:	10 times diameter during installation

## **APPENDIX B:**

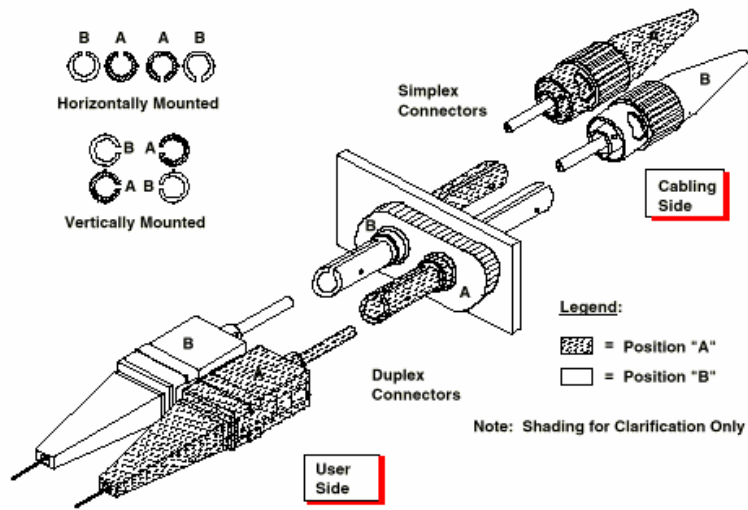
### **Recommended Connector Specifications**

- |   |   |
|---|---|
| <b>Using Standard Connectors</b>              | The 568SC connector is recommended throughout the optical fiber network. If the optoelectronics require other connectors, jumpers can act as a transition between connectors in a system and connectors in the electronics.   |
| <b>Migration Path for ST Compatible Users</b> | <p>Because of the large number of users with an installed base of ST-compatible connectors, the ANSI / TIA / EIA-568-A specification previously recognized a number of viable options for these users.</p> <p>The options are:</p> <ul style="list-style-type: none"><li>• Remain with ST-compatible simplex connectors for both future and existing networks.</li><li>• Switch to a duplex ST-compatible interface which will allow the user to re-use existing connectors and adapters ( see the illustrations below ).</li><li>• Retrofit existing networks by using a hybrid adapter of 568SC to ST compatible.</li><li>• Switch to the 568SC interface for both future and/or existing networks.</li></ul> |

### THE 568SC INTERFACE



### DUPLEX ST-COMPATIBLE INTERFACE



568SC HYBRID ADAPTER

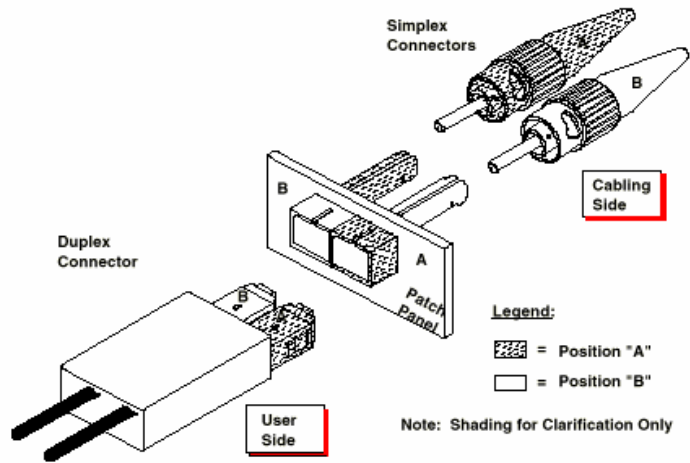


Figure 17 Fiber Connector Types

**REFERENCES – The State of North Carolina expects and enforces strict adherence to the latest published versions of the codes and standards referenced on page 45.**

Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Final Guidelines (July 1991) – 36 CFR Part 1191

Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – TIA / EIA-526 -7 (OFSTP-7)

Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – TIA / EIA-526 -14 (OFSTP-14A)

Commercial Building Telecommunications Wiring Standard – TIA / EIA-568 - B.1

Commercial Building Telecommunications Wiring Standard – TIA / EIA-568 - B.2

Commercial Building Telecommunications Wiring Standard – TIA / EIA-568 - B.3

Telecommunications Pathways and Spaces – TIA / EIA - 569

Residential Telecommunications Cabling Standard – TIA / EIA - 570

Optical Fiber Cable Color Coding – TIA / EIA - 598

Administration Standard for the Telecommunications Infrastructure of Commercial Buildings – ANSI / TIA / EIA-606

Commercial Building Grounding and Bonding Requirements for Telecommunications – TIA / EIA - 607

Customer-Owned Outside Plant Telecommunications Standard – TIA / EIA -758

Detail Specification for 62.5- $\mu$ m Core Diameter / 125- $\mu$ m Class 1a Multimode Graded Index Optical Waveguide Fibers – TIA / EIA - 492AAAA

Generic Requirements for Optical Fiber and Optical Fiber Cable – Bellcore TR-TSY-000020

National Electrical Code (NEC) Articles 600, 700 & 800

National Fire Protection Association (NFPA) NFPA - 71, - 72, - 75, - 780.

BICSI - Telecommunications Distribution Methods Manual (Newest Edition)  
Building Industry Consulting Service International

BICSI - Customer-Owned Outside Plant Design Manual (Newest Edition)  
Building Industry Consulting Service International

Customer –Owned Outside Plant Telecommunications Cabling Standard TIA / EIA –758 - 1



Construction Documents

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding labeling.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-B.

2.2 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Harger Lightning & Grounding.
  2. Panduit Corp.
  3. TE Connectivity Ltd.
  4. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

Construction Documents

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Burndy; Hubbell Incorporated, Construction and Energy.
2. Chatsworth Products, Inc.
3. Harger Lightning & Grounding.
4. Panduit Corp.
5. TE Connectivity Ltd.
6. Additional manufacturers submitted for receiving engineer approval prior to bid.

- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

- D. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Chatsworth Products, Inc.



Construction Documents

2. Harger Lightning & Grounding.
  3. Panduit Corp.
  4. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
  2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
  3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.
- 2.5 IDENTIFICATION
- A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

Construction Documents

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:

Construction Documents

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
  - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.5 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  1. Use crimping tool and the die specific to the connector.
  2. Pretwist the conductor.
  3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

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- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.

3.6 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
  - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
  - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

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- a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
  - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Engineer promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.

END OF SECTION 270526



Construction Documents

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Boxes, enclosures, and cabinets.

1.2 ACTION SUBMITTALS

- A. Product data for each type of product.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. ABB (Electrification Products Division).
  2. Alpha Wire.
  3. Anamet Electrical, Inc (Anaconda Sealite).
  4. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  5. Atkore International (AFC Cable Systems).
  6. Atkore International (Allied Tube & Conduit).
  7. Electri-Flex Company.
  8. Plasti-Bond.
  9. Republic Conduit.
  10. Southwire Company.
  11. Western Tube and Conduit Corporation.
  12. Wheatland Tube Company.
  13. Zekelman Industries (Picoma).
  14. Additional manufacturers submitted for receiving engineer approval prior to bid.
- C. General Requirements for Metal Conduits and Fittings:

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1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  2. Comply with TIA-569-D.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. ARC: Comply with ANSI C80.5 and UL 6A.
- F. IMC: Comply with ANSI C80.6 and UL 1242.
- G. PVC-Coated Steel Conduit: PVC-coated IMC.
1. Comply with NEMA RN 1.
  2. Coating Thickness: 0.040 inch, minimum.
- H. EMT: Comply with ANSI C80.3 and UL 797.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: Steel or die cast.
    - b. Type: Setscrew or compression.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. ABB (Electrification Products Division).
  2. Anamet Electrical, Inc (Anaconda Sealite).
  3. Atkore International (AFC Cable Systems).
  4. Atkore International (Allied Tube & Conduit).
  5. Cantex Inc.
  6. Carlson; a brand of Thomas & Betts Corporation.



Construction Documents

7. CertainTeed Corporation.
8. Condux International, Inc.
9. Dura-Line.
10. Electri-Flex Company.
11. Kraloy Fittings.
12. Lamson & Sessions.
13. Niedax Inc.
14. Orbia Advance Corporation, S.A.B. de C.V. (Dura-Line Communications Group).
15. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
16. Additional manufacturers submitted for receiving engineer approval prior to bid.

C. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Rigid HDPE: Comply with UL 651A.

F. Continuous HDPE: Comply with UL 651A.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

1. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum riser or general-use installation unless otherwise indicated.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Alpha Wire.
2. Carlton; a brand of Thomas & Betts Corporation.
3. Dura-Line.
4. Endot Industries Inc.
5. IPEX USA LLC.
6. Additional manufacturers submitted for receiving engineer approval prior to bid.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

Construction Documents

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. ABB (Electrification Products Division).
  2. Adalet.
  3. Appleton - EGS; Emerson Electric Co., Automation Solutions.
  4. Appleton - O-Z/Gedney; Emerson Electric Co., Automation Solutions.
  5. Carlton; a brand of Thomas & Betts Corporation.
  6. Eaton (Crouse-Hinds).
  7. Erickson Electrical Equipment Company.
  8. FSR Inc.
  9. Milbank Manufacturing Co.
  10. Molex Industrial Products Group; Woodhead Brand.
  11. MonoSystems, Inc.
  12. nVent (Hoffman).
  13. Oldcastle Enclosure Solutions.
  14. Plasti-Bond.
  15. Quazite; Hubbell Incorporated, Power Systems.
  16. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
  17. Spring City Electrical Manufacturing Company.
  18. Stahlin Non-Metallic Enclosures.
  19. Wiremold; Legrand North America, LLC.
  20. Additional manufacturers submitted for receiving engineer approval prior to bid.
- C. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-D.
  2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
  3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or 4 inches by 2-1/8 inches by 2-1/8 inches deep depending on required space.
  5. Gangable boxes are prohibited.
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Metal Floor Boxes:
1. Material: Cast metal.
  2. Type: Fully adjustable.
  3. Shape: Rectangular.
  4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round-

Construction Documents

1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for dry interior spaces Type 3R for exterior spaces Type 4 for interior wet/damp areas with continuous-hinge cover with flush latch unless otherwise indicated.
  1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures:
    - a. Material: Plastic or Fiberglass.
  3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
  1. NEMA 250, Type 1 for dry interior spaces Type 3R for exterior spaces 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.
  6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables. Contractor to confirm sizes with project owner and their IT vendor.
- B. Pathway Fittings: Compatible with pathways and suitable for use and location.
- C. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- ~~D.~~ Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F-

Construction Documents

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA/BICSI 568.
  - 3. TIA-569-D.
  - 4. NECA 101
  - 5. NECA 102.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Install no more than the equivalent of four 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Pathways 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 pathways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
  - 3. Arrange pathways 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 Engineer for each specific location.
- L. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.

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2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- O. 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.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. 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. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
  2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
  3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- S. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway-sealing fittings according to NFPA 70.
- T. Install devices to seal pathway 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 pathways at the following points:
  1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service pathway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- V. Expansion-Joint Fittings:

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1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
  2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Mount boxes at heights indicated on Drawings. Install boxes with height measured to center of box unless otherwise indicated.
- X. 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 surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Y. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- AA. Set metal floor boxes level and flush with finished floor surface.
- BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Install backfill.
  2. After installing conduit, backfill and compact.
  3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. 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 around conduit 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

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inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

4. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications 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.
- 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. 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 COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways 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 or 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 270528





Construction Documents

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

B. Related Requirements:

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles, with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Material for Channel, Fittings, and Accessories: Galvanized steel

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Construction Documents

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  7. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  2. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  6. Toggle Bolts: All-steel springhead type.
  7. Hanger Rods: Threaded steel.

2.3 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.

Construction Documents

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA/BICSI 568.
  - 3. TIA-569-C.
  - 4. NECA 101.
  - 5. NECA 102.
  - 6. NECA 105.
  - 7. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

**Construction Documents**

1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Use expansion anchor fasteners.
  5. 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.
  6. To Steel: –Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69-
  7. To Light Steel: Sheet metal screws.
  8. 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 by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for 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 communications 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 270529

Construction Documents

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS 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. Round sleeves.
  - 2. Rectangular sleeves.
  - 3. Sleeve seal systems.
  - 4. Grout.
  - 5. Pourable sealants.
  - 6. Foam sealants.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Wall Sleeves, Steel:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Advance Products & Systems, LLC.
    - b. CCI Piping Systems.
    - c. Flexicraft Industries.
    - d. GPT; an EnPro Industries company.
    - e. Additional manufacturers submitted for receiving engineer approval prior to bid.
  - 2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

Construction Documents

B. Pipe Sleeves, PVC:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. CCI Piping Systems.
  - b. GPT; an EnPro Industries company.
  - c. Metraflex Company (The).
  - d. Additional manufacturers submitted for receiving engineer approval prior to bid.
2. Description: ASTM D1785, Schedule 40.

C. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Benefast.
  - b. Specified Technologies, Inc.
  - c. Additional manufacturers submitted for receiving engineer approval prior to bid.
2. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Abesco Fire LLC.
  - b. Specified Technologies, Inc.
  - c. Wiremold; Legrand North America, LLC.
  - d. Additional manufacturers submitted for receiving engineer approval prior to bid.
2. Description:
  - a. Material: Galvanized sheet steel.
  - b. Minimum Metal Thickness:
    - 1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness must be 0.052 inch.
    - 2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

Construction Documents

2.3 SLEEVE SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Advance Products & Systems, Inc.
  2. BWM Company.
  3. CALPICO, Inc.
  4. Flexicraft Industries.
  5. Metraflex Company (The).
  6. Pipeline Seal and Insulator, Inc.
  7. Proco Products, Inc.
  8. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable or between pathway and 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: -Fiber-reinforced plastic-
  3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Carlisle SynTec Incorporated.
  2. GAF.
  3. Johns Manville; a Berkshire Hathaway company.
  4. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Description: Single-component, 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.

Construction Documents

2.6 FOAM SEALANTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. Dow Chemical Company (The).
  - 2. Innovative Chemical Products (Building Solutions Group).
  - 3. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    - b. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
  - 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 pathway or cable, unless sleeve seal system 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 Wall Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.



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- D. Roof-Penetration Sleeves: Seal penetration of individual pathways 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 seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:
  - 1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
  - 2. Install steel pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

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

END OF SECTION 270544



Construction Documents

SECTION 281500 - ACCESS CONTROL HARDWARE 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. Card readers, credential cards, and keypads

B. Related Requirements:

- 1. Section 281300 "Access Control System Software and Database Management" for control and monitoring applications, workstations, and interfaces.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- C. Product Schedules.

- D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 OPERATION

- A. Security access system hardware shall use a single database for access-control and credential-creation functions.

2.2 PERFORMANCE REQUIREMENTS

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

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- B. Comply with NFPA 70, "National Electrical Code."

2.3 CARD READERS, CREDENTIAL CARDS, AND KEYPADS

- 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. ABB, Industrial Automation Division.
- 2. Honeywell International Inc.
- 3. Schneider Electric USA, Inc.
- 4. Additional manufacturers submitted for and receiving engineer approval prior to bid.

- B. Card Readers:

- 1. E.C. to coordinate card reader selection and requirements with G.C., owner, and architect.

- C. Keypads:

- 1. E.C. to coordinate keypad selection and requirements with G.C., owner, and architect.

- D. Credential Cards:

- 1. E.C. to coordinate credential cards and requirements with G.C., owner, and architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with TIA 606-B, "Administration Standard for Commercial Telecommunications Infrastructure."
- C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.
- D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

3.2 GROUNDING

- A. Comply with Section 270526 "Grounding and Bonding for Communications Systems."

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- B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.
- E. Signal Ground:
  - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
  - 2. Bus: Mount on wall of main equipment room with standoff insulators.
  - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

**3.3 IDENTIFICATION**

- A. In addition to requirements in this article, comply with applicable requirements in Section 270553 "Identification for Communications Systems" and with TIA 606-B.

**3.4 SYSTEM SOFTWARE AND HARDWARE**

- A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

**3.5 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.
- B. Tests and Inspections:
  - 1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use tester approved for type and kind of installed cable. Test for faulty connectors, splices, and terminations. Test according to TIA 568-C.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for balanced twisted-pair cables must comply with minimum criteria in TIA 568-C.1.
  - 2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated

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battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

END OF SECTION 281500

Construction Documents

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Heat detectors.
7. Fire-alarm notification appliances.
8. Fire-alarm graphic annunciators.
9. Fire-alarm remote annunciators.
10. Digital alarm communicator transmitters (DACTs).
11. Fire-alarm radio transmitters.

B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.
3. Section 284700 "Mass Notification" for mass notification features that are required in addition to fire-alarm system and equipment requirements specified in this Section.

1.2 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. FACU: Fire-alarm control unit.

C. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

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1.3 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
  - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
  - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  - 4. Annunciator panel details as required by authorities having jurisdiction.
  - 5. Detail assembly and support requirements.
  - 6. Include voltage drop calculations for notification-appliance circuits.
  - 7. Include battery-size calculations.
  - 8. Include input/output matrix.
  - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
  - 10. Include performance parameters and installation details for each detector.
  - 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 12. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    - c. Locate detectors in accordance with manufacturer's written instructions.
  - 13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:



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- a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
- c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
- d. Riser diagram.
- e. Device addresses.
- f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
- g. Record copy of site-specific software.
- h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
  - 1) Equipment tested.
  - 2) Frequency of testing of installed components.
  - 3) Frequency of inspection of installed components.
  - 4) Requirements and recommendations related to results of maintenance.
  - 5) Manufacturer's user training manuals.
- i. Manufacturer's required maintenance related to system warranty requirements.
- j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

- 1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
- 2. Installation must be by personnel certified by NICET as fire-alarm technician.
- 3. Licensed or certified by authorities having jurisdiction.

1.6 FIELD CONDITIONS

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

Construction Documents

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:

- 1) Manual stations.
- 2) Heat detectors.
- 3) Smoke detectors.
- 4) Duct smoke detectors.
- 5) Automatic sprinkler system water flow.

c. Fire-alarm signal must initiate the following actions:

- 1) Continuously operate alarm notification appliances-
- 2) Identify alarm and specific initiating device at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
- 3) Transmit alarm signal to remote alarm receiving station.
- 4) Release fire and smoke doors held open by magnetic door holders.
- 5) Switch HVAC equipment controls to fire-alarm mode.
- 6) Recall elevators to primary or alternate recall floors.
- 7) Activate elevator power shunt trip.
- 8) Record events in system memory.
- 9) Indicate device in alarm on graphic annunciator.

d. Supervisory signal initiation must be by one or more of the following devices and actions:

- 1) Valve supervisory switch.
- 2) Zones or individual devices have been disabled.
- 3) FACU has lost communication with network.

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- e. System trouble signal initiation must be by one or more of the following devices and actions:
  - 1) Open circuits, shorts, and grounds in designated circuits.
  - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  - 4) Loss of primary power at FACU.
  - 5) Ground or single break in internal circuits of FACU.
  - 6) Abnormal ac voltage at FACU.
  - 7) Break in standby battery circuitry.
  - 8) Failure of battery charging.
  - 9) Abnormal position of switch at FACU or annunciator.
  - 10) Hose cabinet door open.
  
- f. System Supervisory Signal Actions:
  - 1) Initiate notification appliances.
  - 2) Identify specific device initiating event at FACU, connected network control panels, and remote annunciators.
  - 3) Record event on system printer.
  - 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
  - 5) Transmit system status to building management system.
  - 6) Display system status on graphic annunciator.
  
- g. Network Communications:
  - 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
  - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
  
- h. Document Storage Box:
  - 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
  - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
  - 3) Color: Red powder-coat epoxy finish.
  - 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
  - 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

Construction Documents

2.2 FIRE-ALARM CONTROL UNIT (FACU)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Honeywell International (Fire-Lite Alarms).
  2. Honeywell International (Honeywell Gamewell-FCI).
  3. Honeywell International (Notifier).
  4. Additional manufacturers submitted for receiving engineer approval prior to bid.
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
  2. General Characteristics:
    - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
    - b. Include real-time clock for time annotation of events on event recorder and printer.
    - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
    - d. FACU must be listed for connection to central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
    - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
      - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
    - g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
      - 1) Annunciator and Display: LCD, 80 characters, minimum.
      - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
    - h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.

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- 1) Annunciator and Display: LCD, three line(s) of 80 characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands-
- i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
- 1) Pathway Class Designations: NFPA 72, Class B
  - 2) Pathway Survivability: Level 0
  - 3) Install no more than 256 addressable devices on each signaling-line circuit.
  - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- j. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
  - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
  - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- k. Elevator Recall: Initiate by one of the following alarm-initiating devices:
- 1) Elevator lobby detectors except lobby detector on designated floor.
  - 2) Smoke detectors in elevator machine room.
  - 3) Smoke detectors in elevator hoistway.
- l. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- m. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.
- n. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must not be connected to fire-alarm system.
- o. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- p. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory and DACT must be powered by 24 V(dc) source.
- q. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- r. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

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D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. [Honeywell International \(Fire-Lite Alarms\)](#).
2. [Honeywell International \(Honeywell Gamewell-FCI\)](#).
3. [Honeywell International \(Notifier\)](#).
4. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
2. Station Reset: Key- or wrench-operated switch.
3. Able to perform at up to 90 percent relative humidity at 90 deg F.
4. Able to be used in indoor areas.

2.4 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

- a. [Honeywell International \(Fire-Lite Alarms\)](#).
- b. [Honeywell International \(Honeywell Gamewell-FCI\)](#).
- c. [Honeywell International \(Notifier\)](#).
- d. Additional manufacturers submitted for receiving engineer approval prior to bid.

2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

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- 1) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 2) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 3) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 4) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 5) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 6) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
  - a) Primary status.
  - b) Device type.
  - c) Present average value.
  - d) Present sensitivity selected.
  - e) Sensor range (normal, dirty, etc.).
- 7) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 8) Color: Coordinate with architect.
- 9) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 10) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 11) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 12) Multiple levels of detection sensitivity for each sensor.
- 13) Sensitivity levels based on time of day.

B. Ionization Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. Honeywell International (Fire-Lite Alarms).
  - b. Honeywell International (Honeywell Gamewell-FCI).
  - c. Honeywell International (Notifier).
  - d. Additional manufacturers submitted for receiving engineer approval prior to bid.
2. Performance Criteria:
  - a. Regulatory Requirements:

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- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

- 1) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 2) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 3) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 4) Integral Visual-Indicating Light: LED type, indicating detector has operated.
- 5) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 6) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
  - a) Primary status.
  - b) Device type.
  - c) Present average value.
  - d) Present sensitivity selected.
  - e) Sensor range (normal, dirty, etc.).
- 7) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 8) Color: Selected by architect.
- 9) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 10) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 11) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.

2.5 DUCT SMOKE DETECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Honeywell International (Fire-Lite Alarms).
2. Honeywell International (Honeywell Gamewell-FCI).
3. Honeywell International (Notifier).
4. Additional manufacturers submitted for receiving engineer approval prior to bid.

B. Description: Photoelectric-type, duct-mounted smoke detector.

C. Performance Criteria:



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1. Regulatory Requirements:
  - a. NFPA 72.
  - b. UL 268A.
2. General Characteristics:
  - a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
  - b. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - c. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  - d. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
  - e. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
    - 1) Primary status.
    - 2) Device type.
    - 3) Present average value.
    - 4) Present sensitivity selected.
    - 5) Sensor range (normal, dirty, etc.).
  - f. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
  - g. Each sensor must have multiple levels of detection sensitivity.
  - h. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
  - i. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

A. Combination-Type Heat Detectors:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. [Honeywell International \(Fire-Lite Alarms\)](#).
  - b. [Honeywell International \(Honeywell Gamewell-FCI\)](#).
  - c. [Honeywell International \(Notifier\)](#).
  - d. Additional manufacturers submitted for receiving engineer approval prior to bid.
2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 521.

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- b. General Characteristics:
  - 1) Temperature sensors must test for and communicate sensitivity range of device.
- c. Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
- d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
- e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- f. Detector must have functional humidity range of percent relative humidity.
- g. Color: Coordinate with architect.

B. Fixed-Temperature-Type Heat Detectors:

- 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. [Honeywell International \(Fire-Lite Alarms\)](#).
  - b. [Honeywell International \(Honeywell Gamewell-FCI\)](#).
  - c. [Honeywell International \(Notifier\)](#).
  - d. Additional manufacturers submitted for receiving engineer approval prior to bid.
- 2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 521.
  - b. General Characteristics:
    - 1) Actuated by temperature that exceeds fixed temperature of 190 deg F
    - 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
    - 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
    - 4) Detector must have functional humidity range of 10 to 90 percent.
    - 5) Color: Coordinate with architect.

2.7 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

- 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - a. [Eaton \(Life Safety - Wheelock\)](#).
  - b. [Honeywell International \(Notifier\)](#).
  - c. [Siemens Industry, Inc. \(Building Technologies Division\)](#).

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- d. Additional manufacturers submitted for receiving engineer approval prior to bid.
  - 2. Description: Horns, bells, or other notification devices that cannot output voice messages.
  - 3. Performance Criteria:
    - a. Regulatory Requirements:
      - 1) NFPA 72.
    - b. General Characteristics:
      - 1) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Fire-Alarm Visible Notification Appliances:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    - a. Eaton (Life Safety - Wheelock).
    - b. Honeywell International (Notifier).
    - c. Siemens Industry, Inc. (Building Technologies Division).
    - d. Additional manufacturers submitted for receiving engineer approval prior to bid.
  - 2. Performance Criteria:
    - a. Regulatory Requirements:
      - 1) NFPA 72.
      - 2) UL 1971.
    - b. General Characteristics:
      - 1) Rated Light Output:
        - a) See engineering drawings for light output values.
        - b) 15/30/75/110 cd, selectable in field.
      - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
      - 3) Mounting: Wall mounted unless otherwise indicated.
      - 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
      - 5) Flashing must be in temporal pattern, synchronized with other units.
      - 6) Strobe Leads: Factory connected to screw terminals.
      - 7) Mounting Faceplate: Factory Finish to be selected by architect, must be Red or White.

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2.8 FIRE-ALARM REMOTE ANNUNCIATORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. Bosch Security Systems, Inc.
  - 2. Additional manufacturers submitted for receiving engineer approval prior to bid.
  
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72.
  - 2. General Characteristics:
    - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
      - 1) Mounting: Flush cabinet, NEMA 250, Type 1.
    - b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
  - 1. Bosch Security Systems, Inc.
  - 2. Potter Electric Signal Company, LLC.
  - 3. United Technologies Corporation (UTC Climate, Controls & Security - Edwards).
  - 4. Additional manufacturers submitted for receiving engineer approval prior to bid.
  
- B. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. NFPA 72.
  - 2. General Characteristics:
    - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
    - b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture telephone line(s) and dial preset number for

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remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.

- c. Local functions and display at DACT must include the following:
  - 1) Verification that both telephone lines are available.
  - 2) Programming device.
  - 3) LED display.
  - 4) Manual test report function and manual transmission clear indication.
  - 5) Communications failure with central station or FACU.
  
- d. Digital data transmission must include the following:
  - 1) Address of alarm-initiating device.
  - 2) Address of supervisory signal.
  - 3) Address of trouble-initiating device.
  - 4) Loss of ac supply.
  - 5) Loss of power.
  - 6) Low battery.
  - 7) Abnormal test signal.
  - 8) Communication bus failure.
  
- e. Secondary Power: Integral rechargeable battery and automatic charger.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
  
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
  
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

- 1. Devices placed in service before other trades have completed cleanup must be replaced.
- 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.

- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.

- C. Manual Fire-Alarm Boxes:

- 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
- 2. Mount manual fire-alarm box on background of contrasting color.
- 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.

- D. Smoke- and Heat-Detector Spacing:

- 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
- 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
- 3. Smooth ceiling spacing must not exceed 30 ft..
- 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
- 5. HVAC: Locate detectors not closer than 60 inch from air-supply diffuser or return-air opening.
- 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.

- E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.

- 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

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- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- H. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.
- K. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.

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- 1. Exposed pathways located less than 96 inch above floor must be installed in EMT.
- B. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
  - 1. Magnetically held-open doors.
  - 2. Alarm-initiating connection to elevator recall system and components.
  - 3. Supervisory connections at valve supervisory switches.
  - 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 5. Supervisory connections at elevator shunt-trip breaker.
  - 6. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
  - 7. Supervisory connections at fire-pump engine control panel.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction-
- B. Administrant for Tests and Inspections:



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1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
  2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.
- 3.11 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.-Allow Owner to record training.

END OF SECTION 284621.11



## SECTION 312000 - EXCAVATION AND GRADING

### 1.1 GENERAL

- A. Include all labor, material and equipment necessary for and incidental to the execution of all erosion control, clearing, grubbing, and grading work as shown on the plans.
- B. Visit the site and examine all conditions that may affect the scope of work.
- C. Maintain bench marks and other reference points. If disturbed or destroyed, replace as necessary. Maintain property corners and boundary markers. If disturbed or destroyed, replace as necessary.
- D. Take necessary precautions to prevent blocking of sewers, filling of ditches and washing of earth onto existing pavement during heavy rains. After heavy rains promptly clean up any debris and sedimentation that may have occurred, or might be damaging to sewers, ditches, and pavements. Comply with all local ordinances relative to erosion control. Comply with requirements of the National Pollutant Discharge Elimination System (NPDES) and/or Water Pollution Prevention, as required. The General Contractor to comply with general and specific permit requirements (e.g. notifications, inspection/monitoring, recordkeeping/reporting, maintenance of all erosion control devices, etc.).
- E. Topographic and property surveys giving lot size, ground elevations, obstructions on site, locations and depths of sewers, conduits, pipes, existing structures, curbs, pavements, tracts, and soil boring data giving the nature of ground and sub-surface conditions have been obtained from reliable sources. The accuracy of this data is not guaranteed, and is furnished solely as an accommodation to the Contractor. Use of this data shall be made at the Contractor's discretion. No additional compensation will be granted due to the Contractor's lack of knowledge of site conditions. Prior to bid submission, conduct any additional surveys and soils tests you may deem necessary to verify the accuracy of the information provided.
- F. All site work is to be done in accordance with the plans and specification. The soils report is made available for the convenience of the Contractor. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Additional test borings and other exploratory operations may be made by Contractor. for the purpose of preparing his bid but these will be at no cost to the Owner.

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- G. Contractor is responsible for estimating and calculating all cut and fill quantities. Prior to bid submission the Contractor shall conduct any additional surveys and soil tests he deems necessary to calculate the cut and fill quantities properly. Additional surveys and tests made by the Contractor shall be made at no cost to the Owner.
- H. Contractor is responsible for restoring offsite areas disturbed in performance of the work.
- I. Contractor to maintain clean access drives. Keep mud and construction debris onsite. Clean offsite roadways when needed.
- J. Contractor to provide requested unit prices.

1.2 WORK INCLUDED

- A. Erosion Control measures
- B. Clearing and removal of debris.
- C. Protection of trees.
- D. Topsoil removal and stockpiling.
- E. Grading, Earthwork
- F. Proofrolling
- G. Compaction.
- H. Clean-up.

1.3 WORK SPECIFIED ELSEWHERE

- A. Excavating Support Systems, Section 315000.
- B. Excavation and backfill for Mechanical and Electrical trades.

1.4 QUALITY ASSURANCE

- A. General
  - 1. The Owner will employ and pay for the services of an independent testing agency to provide testing and inspection of the site grading work. The testing agency shall be licensed in the state where the

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- structure is located and all testing and inspections shall be performed under the supervision of an engineer registered in the state where the structure is located.
2. Site grading work and materials shall be tested and inspected as the work progresses. Failure 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's Representative for final acceptance.
  3. The testing agency shall report all test and inspection results to the Civil Engineer, Architect, Owner and Contractor immediately after they are performed. All test and inspection reports shall be signed and sealed by an engineer registered in the state where the structure is located and shall include the exact location of the work represented by the test.
  4. The testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the contract documents, approve or accept any portion of the work, perform any duties of the Contractor, or be a party to scheduling of work.
  5. The Contractor shall notify the testing agency a minimum of 24 hours in advance of all site grading work.
  6. Records of inspection shall be kept available to the building official during progress of work and for two (2) years after completion of the project. Records shall be preserved by the independent testing agency.
- B. The testing agency shall conduct site grading inspections and testing as necessary to determine that:
1. All topsoil and organic matter have been removed from the building and paved areas.
  2. All grading and proofrolling have been performed per the specifications.
  3. Approval of all on-site and off-site fill materials.
  4. All fill materials have been compacted per the specifications.

Construction Documents

1.5 EROSION CONTROL

- A. Install and maintain during construction all erosion control measures as required by local ordinance and as specified on the drawings.

1.6 CLEARING AND REMOVAL OF DEBRIS

- A. All obstructions within the building, paving or planted areas shall be removed. Grub out roots of all trees and remove stumps.
- B. Remove from site all trees, stumps, debris piles, or other refuse encountered during clearing and grading.
- C. Refer to Section 002050, DEMOLITION, and Drawings for demolition work required.

1.7 PROTECTION OF TREES (as applicable)

- A. All trees which are outside the limits of grading operations are to remain in place and be maintained, unless otherwise noted on the plans.

1.8 TOPSOIL REMOVAL & STOCKPILING

- A. Remove all topsoil and organic matter from cut and fill areas before grading operations start.
- B. Stockpile a sufficient amount of topsoil for later distribution in planted areas. All excess topsoil is to be removed from the site.
- C. Before placing fill, remove all debris subject to termite attack, rot or corrosion, and all other deleterious materials from areas to be filled.
- D. If, during the course of excavation work, unsuitable soil per the Soils Report is encountered, soil undercut volume (if any) will be measured in the ground (i.e. in place). Contract unit cost (if any) will be based upon the in-ground volume as measured by the Geotechnical Engineer and the Owner's representative.

1.9 GRADING

- A. Prior to grading, set grade stakes to establish finish contours.
- B. Perform grading to a tolerance of plus or minus 1 inch within building and paved areas.
- C. Allow for the thicknesses of the floor slab and base material within building

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limits, for the pavement and its base in paved areas and for topsoil replacement in landscaped areas.

- D. Unless otherwise indicated on the plans, grading shall be evenly sloped to provide drainage. Round top and bottom of banks and at other breaks in grade.
- E. Provide suitable off-site fill material, or alternately, dispose of all excess material as required, to achieve the final grades shown on the plans.

1.10 ROCK EXCAVATION:

- A. All excavation work shall be considered unclassified.
- B. Should rock be encountered in the cut areas or in the trenches, use a backhoe or ripper until the use of such equipment is not practical.
- C. Remove all rock if encountered, at no additional cost to Owner.
- D. Remove rock to depths designated on plans below slabs, footings, and pavement, and below areas to receive lawns and planting.
- E. When blasting is required, such work shall be conducted only by firms who are specialized and are licensed to do this work and have adequate insurance coverage.

1.11 PROOFROLLING

- A. After clearing, grubbing and organic topsoil removal all areas in the building and pavement footprints shall be densified in place using a medium weight vibratory roller. The purpose of the vibratory rolling is to densify soils loosened by the demolition, to improve the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. The roller shall make at least six passes across the site, with the second set of three passes perpendicular to the first three passes. If water is brought to the surface by the vibratory rolling, the operation shall be discontinued until the water subsides. Vibratory rolling shall be completed during dry weather.

After the vibratory rolling, pore pressures shall be allowed to dissipate for a minimum of 16 hours. After the waiting period, proofrolling shall be performed on the exposed subgrade soils in areas to receive fill or at the subgrade elevation in cut areas with a fully loaded tandem-axel dump truck or similar rubber-tired construction equipment. The proofrolling shall be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade. The proofrolling operations shall be observed by a

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representative of the Geotechnical Engineer. Subgrade soils that exhibit excessive rutting or deflection during proofrolling shall be repaired as directed by the Geotechnical Engineer or the Owner's Representative.

- B. Soft, organic, highly plastic, or excessively wet soils or old fill materials encountered during the proofrolling operation, causing deflection or not acceptable by the Geotechnical Engineer, shall be excavated and replaced with clean fill or material specified by the Geotechnical Engineer in the field to facilitate compaction. Payment for unsuitable soil removal and replacement shall be at the Unit Price for Unsuitable Soil Removal and Replacement.

1.12 COMPACTION

- A. Suitable on-site or off site materials may be used as fill. All fill shall consist of clean material which is free of roots and debris. Refer to Soils Report for acceptable fill materials.
- B. Off-site borrow material must be approved by the independent testing agency. Approval will be based upon the results of tests conducted by a qualified soils testing laboratory.
- C. Fill within building lines and under paved areas shall be placed in loose horizontal layers not more than 9-inches thick (4"-6" in areas where hand operated compaction equipment is used). Interim grade shall always be kept sloped and crowned to facilitate run-off. Place no fill on frozen or on excessively wet or dry subgrade. Fill material shall be at  $\pm 2\%$  of optimum moisture content as determined by the standard Proctor test at the time of placement and compaction.
- D. The bottom of all trenches, and the soil under areas where underground structures are to be constructed and/or installed, shall be compacted to a minimum of 95% of the Standard Proctor maximum dry density, per ASTM D-698 prior to pipe and structure installation. All fill material placed adjacent to and above piping and structures shall be placed in 4'-6 inch layers and shall be compacted to 95% per ASTM D-698. Fill material shall be at  $\pm 2\%$  of optimum moisture content as determined by the standard Proctor test at the time of placement and compaction.
- E. Fill the upper eighteen (18) inches under building slabs & paved areas shall be compacted to 95% of the Standard Proctor maximum dry density (ASTM D-698). Fill material shall be at  $\pm 2\%$  of optimum moisture content as determined by the standard Proctor test at the time of placement and compaction.
- F. Continuous wall footing trenches and individual footing pits shall be



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excavated to footing line and bottom grade. Foundation soils shall be compacted with suitable mechanical equipment to achieve the specified level of density to the required depth. Foundation bottom grade shall be tested to confirm that adequate foundation bearing conditions are present prior to the placement of concrete. Dynamic Cone Penetrometer tests (ASTM 399) shall be used for verification, as determined by the project Geotechnical Engineer.

- G. Contractor shall protect and maintain all finished compacted areas. Any finished compacted subgrade area which deflects one inch (1") or more as a result of construction traffic shall be cut, disced, and recompact or stabilized. The depth of the cut, discing procedure, compaction or stabilization requirements shall be determined by the Geotechnical Engineer in the field.
- H. The Contractor is responsible for wetting, drying, dewatering, and moisture control for subgrade soils.
- I. All fill material shall be free of debris and fibrous organic material.
- J. To ensure workability with a minimum compactive effort, it is essential that the material be kept at or near the optimum moisture content during compaction.
- K. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.
  - 1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
  - 2. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.
  - 3. Stabilization of wet fill material using cement, lime or other chemical methods, and/or geotextiles, will be considered and may be approved subject to the review and approval of the Geotechnical Engineer. Submit proposed stabilization method, including geotextile materials, proposed chemical stabilization materials, mix quantities, or methods and testing criteria for review and approval by the Owner and the Geotechnical Engineer.

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1.13 CLEAN-UP

- A. The entire site shall be raked clean of all trash and other debris after completion of grading work and excess material removed from the site, prior to proceeding with seeding/sodding. Remove all pavement base, etc. from planting areas.
- B. Erosion control measures shall be removed after permanent landscaping has been established, or at a time set by the local authorities.

**END SECTION 312000**

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SECTION 313116 - TERMITE CONTROL

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. Soil treatment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
  - 2. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of termite control product.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
  - 1. Date and time of application.
  - 2. Moisture content of soil before application.
  - 3. Termiticide brand name and manufacturer.
  - 4. Quantity of undiluted termiticide used.
  - 5. Dilutions, methods, volumes used, and rates of application.
  - 6. Areas of application.
  - 7. Water source for application.
- D. Sample Warranties: For special warranties.

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1.5 FIELD CONDITIONS

A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (*Coptotermes formosanus*). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. BASF Corporation; Phantom or Termidor.
  - b. Bayer Environmental Science; Premise 2, Premise 75, Premise Pre-Construction, or Premise Pro.
  - c. Ensystem, Inc; Maxxthor SC, Prother SC2, or Prother WSP.
  - d. Syngenta; Demon Max.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
  - 1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
  - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
  - 2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
  - 3. Crawlspace: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.

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4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

END OF SECTION 313116

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**SECTION 315000 - EXCAVATION SUPPORT SYSTEMS**

1.1 General

- A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. All shoring shall comply with OSHA requirements.
  
- B. Summary
  - 1. This Section includes, but is not limited to, the following:
    - (1) Shoring and bracing necessary to protect existing buildings, streets, walkways, utilities, wetlands and other improvements and excavation against loss of ground or caving embankments.
    - (2) Maintenance of shoring and bracing.
    - (3) Removal of shoring and bracing, as required.
  
  - 2. Types of shoring and bracing systems include, but are not limited to, the following:
    - (1) Steel H-section (soldier) piles.
    - (2) Timber lagging.
    - (3) Steel sheet piles.
  
  - 3. Building excavation is specified in Division 2 Excavation and Grading Section 312000.
  
- C. Submittals
  - 1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  
  - 2. Layout drawings for excavation support system and other data prepared by, or under the supervision of, a qualified Professional Engineer. System design and calculations must be acceptable to local authorities having jurisdiction.
  
- D. Quality Assurance
  - 1. Engineer Qualifications: A Professional Engineer legally authorized to practice in jurisdiction where Project is located, and experienced in providing engineering services for excavation support systems similar in extent required for this Project.
  
  - 2. Supervision: Contractor shall engage and assign supervision of excavation support system to a qualified Professional Engineer foundation consultant.

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3. Regulations: Comply with codes and ordinances of governing authorities having jurisdiction.

E. Job Conditions

1. Before starting work, verify governing dimensions and elevations. Verify condition of adjoining properties. Take photographs to record any existing settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by dated photographs, and signed by Contractor and others conducting investigation.
2. Survey adjacent structures and improvements, employing qualified surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
3. During excavation, resurvey benchmarks weekly, maintaining accurate log of surveyed elevations for comparison with original elevations. Promptly notify Civil Engineer, Architect, and Owner if changes in elevations occur or if cracks, sags, or other damage is evident.

F. Existing Utilities

1. Protect existing active sewer, water, gas, electricity and other utility services and structures.
2. Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal, and discontinuing of services.

1.2 Products

A. Materials

1. General: Provide adequate shoring and bracing materials which will support loads imposed. Materials need not be new, but should be in serviceable condition.
2. Structural Steel: ASTM A 36.
3. Steel Sheet Piles: ASTM A 328.
4. Timber Lagging: Any species, rough-cut, mixed hardwood, nominal 3 inches thick, unless otherwise indicated on the approved layout drawings.



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1.3 Execution

A. Shoring - Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth and hydrostatic pressures.

B. Bracing

Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move a brace, install new bracing prior to removal of original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work, except as otherwise acceptable to Architect.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
4. Remove sheeting, shoring, and bracing in stages to avoid disturbance to underlying soils and damage to structures, pavements, facilities, and utilities.
5. Repair or replace, as acceptable to Civil Engineer, Architect, and Owner, adjacent work damaged or displaced through installation or removal of shoring and bracing work.

**END SECTION 315000**



## SECTION 321216 - ASPHALT PAVING

### 1.1 GENERAL

- A. Include all labor, material and equipment to completely install all bituminous paving.

### 1.2 WORK SPECIFIED ELSEWHERE

- A. Excavation, grading and preparation of sub-grade.

### 1.3 SUBMITTALS

- A. Asphalt mix design shall be submitted to the Civil Engineer.

### 1.4 QUALITY ASSURANCE

#### A. General

1. The Owner will employ and pay for the services of an independent testing agency to provide testing and inspection of the asphaltic concrete and stone base work. The testing agency shall be licensed in the state where the structure is located and shall meet the requirements of "Recommended Practices for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction" (ASTM E329). All testing and inspections shall be performed under the supervision of an engineer registered in the state where the structure is located.
2. Asphaltic concrete and stone base materials and operations shall be tested and inspected as the work progresses. Failure 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's Representative for final acceptance.
3. The testing agency shall report all test and inspection results to the Civil Engineer, Architect, Owner and Contractor immediately after they are performed. All test and inspection reports shall be signed and sealed by an engineer registered in the state where the structure is located, and shall include the exact location of the work represented by the test.
4. The testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the contract documents, approve or accept any portion of the work, perform any duties of the Contractor, or be a party to scheduling of work.

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5. The Contractor shall notify the testing agency a minimum of 24 hours in advance of all asphaltic concrete and stone base work.
  6. Records of inspection shall be kept available to the building official during progress of work and for two years after completion of the project. Records shall be preserved by the independent testing agency.
- B. The testing agency shall conduct pre-placement inspections as necessary to determine that:
1. Paving subgrade areas have been constructed per the Soils Report and specifications criteria.
  2. All paving section subgrade areas have been inspected, tested and accepted.
- C. The testing agency shall conduct tests as necessary to determine that:
1. All materials used in the production of asphaltic concrete and stone base meet the requirements of the project specifications.
- D. The testing agency shall conduct asphaltic concrete and stone base placement inspections as necessary to determine that:
1. Asphaltic concrete has been mixed and transported in accordance with the project specifications.
  2. Asphaltic concrete is conveyed to the place of final deposit by methods which prevent separation or loss of material.
  3. Asphaltic concrete and stone base are properly compacted. Perform at least one density test for every 20,000 SF of pavement area. Verify stone base thickness by checking stone base thickness at least once for every 20,000 SF of pavement area.
  4. Asphaltic concrete is finished within the tolerances specified in section 1.11 (C) (7) below.
- E. The testing agency shall conduct post-placement inspection as necessary to determine that:
1. All surface defects are repaired in accordance with the project specifications.

## 1.5 TRANSPORTATION OF MIXTURES

- A. The mixture shall be transported from the paving plant to the work in tight vehicles with metal bottoms previously cleaned of all foreign materials. The truck beds shall be raised and the inside lubricated with a thin oil to prevent the mixture from adhering to the bed. An excess of lubricant will not be permitted. Each load shall be covered with canvas or other suitable material of sufficient size to protect it from the weather.

## 1.6 MATERIALS

- A. Aggregate for rolled stone base course shall be clean, crushed rock, free from thin or elongated pieces, soft or disintegrated materials, or other foreign matter. Stone shall meet the criteria established for crushed stone base established by the local Department of Transportation.
- B. Base Paving Section Bid: Include in bid the cost to install pavement cross section as recommended in the Soils Report and as detailed on the drawings.

## 1.7 AGGREGATE FOR ASPHALTIC CONCRETE

- A. Coarse Aggregate shall be natural crushed stone produced from sound, durable rock, free from objectionable coatings. This aggregate shall conform to the requirements of ASTM D-692 and local D.O.T. Standard Specification.
- B. Fine Aggregate shall consist of natural sand or by special permission may be fines produced by the crushing of natural stone. The fine aggregate shall conform to the requirements of ASTM C-1073 and mineral filler shall conform to ASTM D-242 and local D.O.T. Standard Specification.
- C. Asphalt Cement shall conform to ASTM D-946 and local D.O.T. Standard Specification.

## 1.8 ASPHALTIC CONCRETE MIXTURES

- A. Asphaltic concrete mixture shall consist of mineral aggregates and asphalt cement combined in such proportions that the composition by weight of the finished mix shall be within the following range for the type specified.
- B. Asphaltic concrete mixture shall be type per local D.O.T. Standard Specifications for Road and Bridge (latest edition) for the type and thickness specified on the plans.

1.9 ROLLED STONE BASE

- A. Preparation of Mixture: The exact proportions of aggregate and water shall be regulated so as to produce a uniform satisfactory mixture. The order of sequence in which the aggregate and water shall be drawn or weighted may vary under different conditions. The percentage of water in the mixture may vary with moisture conditions and sources of aggregate, but in no case shall the percentage of water be more than 12 percent by weight, of the total mixture. The finished mixture shall have a moisture content necessary to obtain the maximum density required to comply with the standard compaction test herein specified. In general, the proper moisture content can be judged by the appearance of free water on the surface of the particles. Excess moisture resulting in run-off shall be avoided.

1.10 CONSTRUCTION OF STONE BASE

- A. In no case will the Contractor be permitted to place the mixture or manipulate it on muddy or frozen subgrade. Also, no frost or frozen particles shall be placed on the subgrade or compacted.
- B. Before starting the construction of surface courses, the base shall be cleaned and adjusted to conform with the cross section shown on the plans and to the lines, grades and thickness established. For the purpose of these specifications, this work shall include sweeping, removing all loose, caked or foreign materials. The total cost of adjusting and compacting subgrades and for cleaning and restoring base courses shall be included in the contract price.
- C. After the subgrade has been properly prepared, the mixture shall be uniformly spread by blades, or other approved equipment, in successive layers of courses to such depth that, when compacted, the base will have the minimum thickness shown on the typical cross section. The Contractor may construct the base in any number of layers which he may find convenient to facilitate compacting, except that, in no case, shall any individual layer have a compacted thickness of more than 4". Each layer shall be compacted, as hereinafter specified, before any succeeding layer is placed. Placement of base shall be in accordance with local D.O.T. Standard Specification.
- D. If the mixture becomes too dry to permit compaction, water shall be added during the compacting operations in such an amount as to insure proper compaction. If for any reason, the mixture is too wet for proper compaction it shall be allowed to dry until the proper moisture content is obtained.
- E. The mixture shall be handled in such manner as to avoid undue segregation.

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If segregation occurs or if the mixture becomes contaminated, such segregated or contaminated materials shall be replaced with materials of suitable quality and gradation, except that areas of surface segregation may be corrected by spreading a quantity of stone screening sufficient to close the voids and bind the loose material firmly in place. The screening shall be wet and rolled so as to create a dense and uniform surface. Segregated or contaminated materials shall be removed and replaced with suitable material at the sole expense of the Contractor. The Contractor shall restrict hauling over the completed or partially completed work after inclement weather, or at any time when subgrade material is soft and there is tendency for the subgrade material to work into the surface material. Any screenings used in correcting areas of surface segregation will be measured and paid for as a part of the aggregate constituting the base course. All extra work or expense involved due to screenings being required shall be the Contractor's obligations without extra cost to Owner. Compaction shall be performed by the use of any approved equipment, within the limits of these specifications, which will produce satisfactory results.

- F. Shaping and compaction shall be carried on until a true, even, uniform base course of the proper grade, cross section and density is obtained. Proper moisture content shall be maintained by wetting the surface as required during shaping and compacting operations. The use of excess water, resulting in run-off or in the formation of a slurry on the surface, shall be avoided.
- G. Final rolling on the top course of multiple course construction or the top of single course construction shall be accomplished by self-propelled smooth-wheeled roller weighing not less than seven (7) tons, nor more than ten (10) tons.
- H. The density to be obtained in the completed base shall be at least 98% of the Standard Proctor maximum dry density, per ASTM D-698.

**1.11 CONSTRUCTION OF ASPHALTIC SURFACE**

- A. Mixing Plant shall conform to ASTM D-995 and local D.O.T. Standard Specification.
- B. Preparation of Mixture: The bituminous cement shall be carefully heated without damage by overheating to a workable temperature. The final mixture shall not exceed 350 degrees F. when discharged.
- C. Application
  - 1. Spreading of mixture shall be done at mixture temperature above 250 degrees F. and only when weather conditions are suitable.

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2. Use hand rakers for inaccessible locations and mechanical spreading and finishing machine of type approved by owner's Representative.
3. Side forms to serve as screed or strike off control to insure surface true to elevation or to prevent squeezing out or side shoving under roller or lateral displacement shall be used where applicable. Forms shall be of height equal to thickness of finished course.
4. Rolling shall be carried out while mixture is still hot, with self-propelled roller having weight of 200 lbs. per lineal inch of roller. Rolling shall be paralleled to spreading of mixture, from edge toward center, and in manner consistent with good practice getting proper compaction without cracking, shoving or otherwise displacing mixture during hardening process. All places inaccessible to roller shall be compacted by hand tampers or vibratory plates.
5. Mixture shall be placed continuously. Roller shall not pass over unprotected end of freshly laid mixture unless further laying is to be delayed for sufficient time to permit mixture to become chilled. In such case, edge of mixture shall be cut back and trimmed to expose unsealed or granular surface for full specified depth of finish course.
6. At end of each day's work, joints shall be formed by laying and rolling mixture against boards of thickness of compacted mixture. When laying is resumed, above mentioned exposed edges shall be painted with thin coat of asphaltic cement, and fresh mixture shall be raked against joint, thoroughly tamped with hand tampers, and rolled.
7. After final compression, the surface shall be smooth and true to the established crown and grade. It shall have the average thickness specified and shall at no point vary more than one quarter (1/4) inch from the specified thickness. Any low or defective places shall immediately be remedied by cutting out the course at such spots and replacing it with fresh hot mixture which shall be immediately compacted to conform with surrounding area and shall be thoroughly bonded to it. The finished pavement shall be set free from depressions exceeding one-eighth (1/8) inch as measured with a ten (10) foot straight edge paralleling the center line of the roadway. No traffic shall be permitted on the finished pavement until it has cooled to atmospheric temperature.

#### 1.12 PAVEMENT PAINTING

- A. Scope of Work



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1. Layout and paint white striping on parking lot surfaces designating parking spaces, driving lanes and other elements noted on the site drawings. Comply with local ordinances when completing this work.
2. Do not apply paint in snow, rain, fog or mist, or when relative humidity exceeds 85% unless otherwise permitted by manufacturer. When surface temperature is below 50 degrees F. do not apply paints and special coatings, unless otherwise specified. Stop exterior work sufficiently early to permit film to set up before condensation, frost and moisture, caused by night temperature drops, occur. Do not begin exterior painting until frost or condensation evaporates and surface is moisture free. Comply with manufacturer's written requirements and local D.O.T Standard Specification.
3. Traffic paint shall be installed in two (2) coats. The minimum required total Dry Film Thickness (DFT) shall be measured in mils.

B. Materials

1. Parking Areas: All parking lot striping and arrows:

2 coats Pratt and Lambert Traffic Paint (or approved equal - each coat  
2.0 mils DFT)  
30 days between coats.  
Color: White.

1.13 PROTECTION

- A. Provide adequate protection for all adjacent work and areas against any damage or injury by employees, materials, tools, or equipment used in connection with this contract.
- B. Maintenance of finished asphaltic concrete surfacing will be required until acceptance of work by Owner.

**END SECTION - 321216**



## SECTION 321313 - PORTLAND CEMENT CONCRETE PAVING

### 1.1 General

- A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Summary
  - 1. Extent of Portland cement concrete paving is shown on drawings, including curbs, gutters, walkways, sidewalks, flumes, and pavement.
  - 2. Prepared sub-base is specified in "Excavation and Backfill" section.
  - 3. Concrete and related materials.
  - 4. Joint fillers and sealers.
  - 5. See Division 3 for concrete used within buildings and structural concrete.
- C. Submittals: Provide samples, manufacturer's product data, test reports, and materials certifications as required in referenced sections for concrete and joint fillers and sealers.
- D. Quality Assurance: Codes and Standards - Comply with local governing regulations if more stringent than herein specified.
- E. Job Conditions - Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
  - 1. Coordinate with requirements for "Temporary Facilities" specified in Division 1.

### 1.2 Products

- A. Materials
  - 1. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.

- (1) Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.
2. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A-185.
3. Reinforcing Steel: Deformed billet steel bars, ASTM A615, grade 40.
4. Portland cement concrete for curb and gutter, sidewalks and miscellaneous cast-in-place flumes and other minor site structures shall have a minimum 28 day compressive strength of 3500 psi, a non-vibrated slump between 2.5 and 4 inches, minimum cement content of 564 pounds per cubic yard, an air entrainment of 5-7% and a maximum water-cement ratio of 0.57.
5. Portland cement concrete for slabs in front of loading docks and dumpsters shall have a minimum 28 day compressive strength of 4500 psi, a non-vibrated slump between 2.5 and 4 inches, minimum cement content of 658 pounds per cubic yard, an air entrainment of 5-7% and a maximum water-cement ratio of 0.49.
6. Joint filler shall be self-leveling flexible polyurethane joint sealant.
  - (1) Products:
    - a. Euclid Chemical Co: Eucolastic II.
    - b. Pecora: urexpan NR 200.
    - c. Sonneborn Building Products – Sonoclastil SL 2 Sealant.
    - d. Tremco: THC 900.
    - e. Vulkem: Vulkem 45.
  - (2) Description:
    - a. Hardness- Shore “A”: A30 minimum
    - b. Movement Capability: +/-25%.
    - c. USDAQ Approved.
7. Concrete curing agents shall be free from any impurities which may be detrimental to the concrete and meet the requirements specified in Section 296 of North Carolina Department of Transportation Standard Specifications for Roads and Structures.
8. Aggregate for Portland cement concrete shall meet the requirements for fine and course aggregate of Section 914 of the North Carolina

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Department of Transportation Standard Specifications for Roads and Structures.

9. Portland cement and admixtures shall meet the requirements of Section 1000-4 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.
10. Water for mixing or curing the concrete shall be free from injurious amounts of oil, salt acid or other products injurious to the finished.

### 1.3 Concrete Mix, Design, and Testing

#### A. Design

1. Comply with requirements of applicable Division 3 sections for concrete mix design, sampling and testing, and quality control and as herein specified.
2. Design mix to produce normal-weight concrete consisting of Portland cement, aggregate, water-reducing or high-range water-reducing admixture (superplasticizer), air-entraining admixture, and water to produce the following properties:

For curb and gutter, sidewalks and miscellaneous cast-in-place flumes and other minor site structures:

- (1) Compressive Strength: 3500 psi, minimum at 28 days, unless otherwise indicated.
  - (2) Non-vibrated slump between 2.5 and 4 inches.
  - (3) Minimum cement content of 564 pounds per cubic yard.
  - (4) Air entrainment of 5-7%.
  - (5) Maximum water cement ratio of 0.532.
3. For slab in front of loading docks and dumpster pads:
    - (1) Compressive Strength: 4500 psi, minimum at 28 days, unless otherwise indicated.
    - (2) Non-vibrated slump between 2.5 and 4 inches.
    - (3) Minimum cement content of 658 pounds per cubic yard.
    - (4) Air entrainment of 5-7%.
    - (5) Maximum water cement ratio of 0.49.

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1.4 Execution

A. Surface Preparation

1. Remove loose material from compacted sub-base surface immediately before placing concrete.
2. Proof-roll prepared sub-base surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

B. Form Construction

1. Set forms to required grades and lines, braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
  - (1) Slope step treads at 1/4 inch per foot to drain.
2. Reinforcement: Locate, place and support reinforcement as indicated.

C. Concrete Placement

1. General: Comply with requirements of Division 3 sections for mixing and placing concrete, and as herein specified.
2. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
3. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than 1/2 hour, place a construction joint.
4. Curbs and Gutters: Automatic machine may be used for curb

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and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results that meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

5. Concrete Paving: Place concrete using a concrete pump; depositing concrete directly from a concrete truck will not be allowed for concrete paving. Driving loaded concrete trucks over prepared subgrade will not be allowed.

D. Joints

1. General: Construct expansion, weakened-plane (contraction), and construction joints true to line with face perpendicular to surface of concrete.
2. Sawed Joints: Form weakened-plane joints with powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints one inch (1") deep into hardened concrete at maximum fifteen foot (15') spacing, in both directions, as soon as surface will not be torn, abraded, or otherwise damaged by cutting action. Seal with joint filler material as specified below.
3. Inserts: Use embedded strips of metal to form weakened-plane joints. Carefully set strips into plastic concrete.
4. Expansion joints: Use pre-molded expansion joint material. Seal joints with joint filler material as specified below.
5. Construct transverse joints at right angles to the centerline, unless otherwise indicated. Construct contraction joints at intervals equal to the width of sidewalks and at 10' maximum spacing in curb and gutter and slabs. Seal joints with joint filler material as specified below.
6. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for more than 1/2 hour, except where such placements terminate at expansion joints. Seal joints with joint filler material as specified below.

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7. Expansion Joints: Provide pre-molded expansion joint filler abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated. Provide expansion joint at a maximum 50' spacing (or as indicated on the plans) for slabs, sidewalks and curb and gutter. Seal joints with joint filler material as specified below.
8. Joint filler material shall be mixed and installed in strict accordance with manufacturer's printed installation instructions except where more stringent requirements are shown or specified. Joint surfaces shall be primed as required by manufacturer to insure bonding. Provide backer rod in joint at a uniform depth of  $\frac{1}{2}$  the joint width, a minimum depth of  $\frac{1}{4}$ " and a maximum depth of  $\frac{1}{2}$ ". Take all necessary steps to prevent three sided adhesion. Final cured profile shall be flush with concrete slab surface. See Section B.1.f. – Products.

E. Concrete Finishing

1. After striking-off and consolidating concrete, smooth surface by screening and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
2. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
3. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.
4. After completion of floating and troweling when excess moisture or surface sheen has disappeared, broom surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to owner.
5. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or



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sections with major defects, as directed by Owner.

6. For joint sealing see Section D - Joints

F. Curing:

1. Protect and cure finished concrete paving in compliance with applicable requirements of Division 3 sections.
2. Repairs And Protections: Repair or replace broken or defective concrete, as directed by Architect.

1.5 QUALITY ASSURANCE

A. General

1. The Owner will employ and pay for the services of an independent testing agency to provide testing and inspection of the Portland Cement Concrete and stone base work. The testing agency shall be licensed in the state where the structure is located and shall meet the requirements of "Recommended Practices for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction" (ASTM E329). All testing and inspections shall be performed under the supervision of an engineer registered in the state where the structure is located.
2. Portland cement concrete and stone base materials and operations shall be tested and inspected as the work progresses. Failure 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's Representative for final acceptance.
3. The testing agency shall report all test and inspection results to the Project Manager, Owner and Contractor immediately after they are performed. All test and inspection reports shall be signed and sealed by an engineer registered in the state where the structure is located and shall include the exact location of the work represented by the test.

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4. The testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the contract documents, approve or accept any portion of the work, perform any duties of the Contractor, or be a party to scheduling of work.
5. The Contractor shall notify the testing agency a minimum of 24 hours in advance of all Portland cement concrete and stone base work.
6. Records of inspection shall be kept available to the building official during progress of work and for two years after completion of the project. Records shall be preserved by the independent testing agency.
7. The testing agency shall conduct pre-placement inspections as necessary to determine that:
  - (1) Paving subgrade areas have been constructed per the Soils Report and specifications criteria
  - (2) All paving section subgrade areas have been inspected, tested and accepted.
8. The testing agency shall conduct tests as necessary to determine that:
  - (1) All materials used in the production of Portland concrete meet the requirements of the project specifications.
  - (2) The testing agency shall conduct Portland cement concrete and stone base placement inspections as necessary to determine that:
  - (3) Portland cement concrete has been mixed and transported in accordance with the project specifications.
  - (4) Portland cement concrete is conveyed to the place of final deposit by methods which prevent separation or loss of material.
  - (5) Portland cement concrete and stone base are properly compacted. Perform at least one density test for every 20,000 SF of pavement area. [Verify stone base

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thickness by checking stone base thickness at least once for every 20,000 SF of pavement area.

- (6) Portland cement concrete is finished free from depressions exceeding one-eighth (1/8) inch as measured with a ten (10) foot straight edge in any direction.
9. The Owner shall conduct post-placement inspection as necessary to determine that:
    - (1) All surface defects are repaired in accordance with the project specifications.

**-END OF SECTION-**



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SECTION 323117 – ORNAMENTAL WELDED WIRE FENCE AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hot dip galvanized, polyester powder finish coated, steel fencing panel, post and accessory system.
  - 2. Gate operator.
  - 3. Grounding and bonding.
- B. Related Sections include the following:
  - 1. Division 31 "Earthwork" for filling and for grading work.
  - 2. Section 033000 "Cast-in-Place Concrete" for concrete equipment bases/pads for gate operators, drives, and controls and post footings.
  - 3. Division 26 "Electrical" for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches.

1.3 SUBMITTALS

- A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:
  - 1. Fence and gate posts, rails, and fittings.
  - 2. Gates and hardware.
  - 3. Gate operators, including operating instructions.
  - 4. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show locations of fence, each gate, posts, rails, and details of gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.
  - 1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.

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2. Wiring Diagrams: Power and control wiring and communication features and access control features. Differentiate between manufacturer-installed and field-installed wiring and between components provided by gate operator manufacturer and those provided by others.
- C. Samples for Initial Selection: Manufacturer's color charts or 6-inch (150-mm) lengths of actual units showing the manufacturer's standard range of colors available for components with factory-applied color finishes.
- D. Samples for Verification: For the following products, in sizes indicated. Prepare Samples from the same material to be used for the Work.
  1. Polyester powder coating in 6-inch (150-mm) lengths on shapes for posts, rails, gate framing and wires, and on full-sized units for accessories.
- E. Product Certificates: Signed by manufacturers of fences and gates certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:
  1. Finishes.
  2. Gate operator.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Fences and Gates: Obtain each color, grade, finish, type, and variety of component for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.
- C. 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.
- D. UL Standard: Provide gate operators that comply with UL 325.
- E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

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1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.
- B. Field Measurements: Verify layout information for fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Subject to compliance with requirements, provide the following product, or comparable product as approved by the Architect:
  - 1. TWINBAR® Fencing System:
    - a. MFR Manufacturing Corp, Inc..  
1065 Sill Ave  
Aurora, IL 60506  
TEL: 815-552-3333 FAX: 815-552-3315  
Website: [www.mfrcorp.com](http://www.mfrcorp.com) e-mail: info@mfrcorp.com

2.2 FENCE POSTS

- A. Posts are made of square or rectangular tubular steel of different sizes depending on the required overall height.

2.3 FENCE PANELS

- A. Steel Mesh Fence Panels: Consisting of prefabricated panels of wire mesh formed by vertical rods placed between two horizontal rods. The rods are electro-forged welded at each crossing. The standard panel length is 8'-3". Heights of more than 8' are accomplished by combining panels with a different or equal height. Mesh is galvanized and powder polyester coated after fabrication into panels..
- B. Provide fabricated panels of height, mesh size and with post **size** as indicated below:

Type TWINBAR®  
Meshsize 2" x 8" (50x200mm) on center  
Vertical rods are dia. 1/4"= 4-gauge, (6mm)  
2 Horizontal rods are dia. 1/4"= 4-gauge, (6mm)

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Panel Width and Post Spacing 8'-3" (2510mm)  
Fence Types and Height available

Panel Height	Mesh Size available	Post Type
6'-0" (1830)	2" x 8"(50x200)	2-3/8" x 1-5/8" (60x40)

2.4 GATES

A. This Section includes the following:

1. Double swing gate.

B. Metal Tubing framed gates, to match panel system. Steel, galvanized and powder polyester coated after fabrication.

1. Gate Height: 5 feet.

C. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops and, for each gate leaf more than 5 feet (1.5 m) wide, keepers. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.

D. Slide Gate Track Assembly: Manufacturer's standard track, with framing supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

E. Guide Posts and Roller Guards.

2.5 GATE OPERATOR

A. General: Provide factory-assembled automatic gate operation system designed for gate size, type, weight, construction, use, traffic-flow patterns, and operation frequency. Provide operation system for gate specified, of size and capacity and with features, characteristics, and accessories suitable for Project conditions, recommended and provided by gate manufacturer complete with electric motor and factory-prewired motor controls, remote-control stations, control devices, power disconnect switch, obstruction detection device, lockable weatherproof enclosures protecting controls and all operating parts, and accessories required for proper operation. Provide enclosures with corrosion-resistant-protective and decorative finish and two keys per lock. Include wiring from motor controls to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
2. Provide operator with UL approval.
3. Provide electronic components with built-in troubleshooting diagnostic feature.
4. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.



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- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- D. Electrohydraulic Operation: Provide unit designed for mounting in location as selected by the Architect; consisting of electric motor, pump, hydraulic actuator to suit gate type, valves, heater to maintain constant temperature, and cold-weather hydraulic fluid; with hydraulic locking in both directions.
- E. Operation Cycle Requirements: Design gate operator to operate for not less than the following duty and cycles per hour. One cycle equals one gate opening plus one gate closing.
  - 1. Heavy Duty: 25 cycles per hour.
- F. Gate Operation Speed: Minimum 45 fpm.
- G. Electric Motors: High-starting torque, reversible, continuous-duty, insulated electric motors, complying with NEMA MG 1, sized to start and operate size and weight of gate considering Project's service conditions without exceeding nameplate ratings or considering service factor.
  - 1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
  - 2. Enclosure: Totally enclosed, nonventilated or fan-cooled motors, fitted with plugged drain.
  - 3. Thermal Protection: Internal manual reset.
  - 4. Motor: Motor horsepower as recommended by operator manufacturer.
- H. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 4 enclosure for mounting as selected by the Architect, and with space for additional optional equipment. Provide remote-control device(s) as selected by the Architect from the manufacturer's full range.
  - 1. Control Station: As selected by the Architect from the manufacturer's full range.
  - 2. Card Reader: As selected by the Architect from the manufacturer's full range.
  - 3. Digital Keypad Entry Unit: As selected by the Architect from the manufacturer's full range.
  - 4. Vehicle Loop Detector System: System including automatic closing timer with adjustable time delay before closing timer cut-off switch and loop detector designed to open and close gate, hold gate open until traffic clears, and reverse gate. Provide electronic detector, with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, as recommended in writing by detection system manufacturer for function indicated.
    - a. Loop: Wire, in size indicated for field assembly, and sealant; style for pave-over or saw-cut installation.

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5. Vehicle Presence Detector: System including automatic closing timer with adjustable time delay before closing timer cut-off switch and presence detector designed to open and close gate, hold gate open until traffic clears, and reverse gate. Provide retroreflective or emitter/receiver type detector, with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway by interrupting an infrared beam in zone pattern and to emit a signal activating the gate operator.
- I. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
  1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.
  2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
  3. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in partition's path by interruption of an infrared beam in the zone pattern without obstruction contacting gate.
- J. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
- K. Emergency Release Mechanism: Quick disconnect release of operator drive system of the following type of mechanism, permitting manual operation if operator fails. Design system so control circuit power is disconnected during manual operation.
  1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.
- L. Operating Features: Include the following:
  1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability of monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
  2. Fully Systems Compatible: With controlling circuit board capable of accepting any type of input from external devices.
  3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
  4. Automatic Closing Timer: With adjustable time delay before closing and timer cut-off switch.
  5. Open Override Circuit: Designed to override closing commands.
  6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
  7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
  8. Clock Timer: 24-hour, seven-day programmable for regular events.
- M. Accessories: Include the following:
  1. Mounting kit including pedestal.
  2. Audio Warning Module: Provide ADA-compliant audible alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving.

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3. Visual Warning Module: Provide ADA-compliant visible constant- or strobe-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving.
4. Battery Backup System: Battery-powered drive and access control system, independent of primary drive system, opening gate if power fails.
5. External electric-powered lock with delay timer allowing time for lock to release before gate operates.
  - a. Type: Solenoid or magnetic for swing gate.
6. Fire and/or Postal box if required.
7. Fire strobe and/or siren sensor if required.
8. Instructional, Safety, and Warning Labels and Signs: Manufacturer's standard for components and features specified.

2.6 CAST-IN-PLACE CONCRETE

- A. General: Comply with Section 033000 "Cast-in-Place Concrete."

2.7 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

2.8 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
  1. Material Above Finished Grade: Copper or aluminum as selected by the Architect.
  2. Material On or Below Finished Grade: Copper.
  3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Ground Rods: Listed in UL 467.

PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
  - 1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

- A. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
- C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to set posts is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.
  - 1. Dimensions and Profile: 12” diameter for terminal posts, 10” diameter for intermediate posts. Concrete to be 6” deeper than post length in ground.
  - 2. Concealed Concrete Footings: Stop footings 2 inches (50 mm) below grade to allow covering with surface material.
  - 3. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
  - 4. Mounting Plate Installation: Bolt mounting plates attached to each post to slab or structure as indicated, using expansion bolts.

3.4 FENCE INSTALLATION

- A. Terminal Posts: Locate terminal end, corner, and gate posts at changes in horizontal or vertical

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alignment of 15 degrees or more.

- B. Line Posts: Space line posts uniformly at 8 feet 3 inches o.c.
- C. Mesh Panels: Apply panels to outside of enclosing posts. Leave 1 inch between finish grade or surface and bottom of panel, unless otherwise indicated. Anchor panel to posts with pre-assembled mounting brackets lock bar. All post-panel connections are utilizing a patented nylon setting to reduce rattling noise caused by wind, vibrations or other sources
- D. Fasteners: install nuts on the side of the fence opposite the panel side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

- A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for Support Posts, Pedestals, and Concrete Bases/Pads: Hand-excavate holes for bases/pads, in firm, undisturbed or compacted soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated on Drawings.
- C. Concrete Bases/Pads: Cast-in-place or precast concrete, made of not less than 3000-psi (20.7-MPa) compressive strength (28 days), depth not less than 12 inches (300 mm), dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.
- D. Vehicle Loop Detector System: Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.7 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:
  - 1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).

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- a. Gates and Other Fence Openings: Ground fence on each side of opening.
  - 1) Bond metal gates to gate posts.
  - 2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2, unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a ground rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.8 FIELD QUALITY CONTROL

- A. Ground-Resistance Testing Agency: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- B. Ground-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure ground resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by two-point method according to IEEE 81.
- C. Desired Maximum Grounding Resistance Value: 25 ohms.

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- D. Excessive Ground Resistance: If resistance to ground exceeds desired value, notify Architect promptly. Include recommendations to reduce ground resistance and proposal to accomplish recommended work.
- E. Report: Prepare test reports, certified by testing agency, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.9 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operator: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.
  - 1. Electrohydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test controls, alarms, and safeties. Remove damaged and malfunctioning units, replace with new units, and retest.
- C. Lubricate hardware, gate operator, and other moving parts.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates.
  - 1. Test and adjust operators, controls, alarms, safety devices, hardware, and other operable components. Replace damaged or malfunctioning operable components.
  - 2. Train Owner's personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
  - 4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  - 5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 323117





Construction Documents

SECTION 323119 - DECORATIVE METAL GATES

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. Decorative metallic-coated-steel swing gates with metal panel slat infill at dumpster enclosure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each gate material and for each color specified.
  - 1. Provide Samples 12 inches in length for linear materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Product Test Reports: For decorative metallic-coated-steel gates, including finish, indicating compliance with referenced standard and other specified requirements.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

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Construction Documents

- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

**2.2 SWING GATES**

- A. Gate Configuration: Double leaf.
- B. Gate Frame Height: As indicated.
- C. Gate Opening Width: As indicated.
- D. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes 2 by 2 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication, unless otherwise indicated.
- E. Frame Corner Construction: Welded or assembled with corner fittings and 5/16-inch-diameter, adjustable truss rods for panels 5 feet wide or wider.
- F. Infill: Horizontal metal panel slat infill as selected by the Architect.
- G. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet wide. Provide center gate stops and cane bolts for pairs of gates.
- H. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
  - 1. Function: 39 - Full surface, triple weight, antifriction bearing.
  - 2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- I. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2-inch- diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.
- J. Finish exposed welds to comply with NOMMA Guideline 1, Finish #4 - good-quality, uniform undressed weld with minimal splatter.

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- K. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
- L. Metallic-Coated-Steel Finish: High-performance coating.

2.3 STEEL AND IRON

- A. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Bar Grating: NAAMM MBG 531.
  - 1. Bars: Hot-rolled steel strip, ASTM A 1011/A 1011M, Commercial Steel, Type B.
  - 2. Wire Rods: ASTM A 510.
- E. Uncoated Steel Sheet: Cold-rolled steel sheet, ASTM A 1008/A 1008M, Structural Steel, Grade 50.
- F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50, with G90 coating.
- G. Aluminum-Zinc, Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, with AZ60 coating.
- H. Castings: Either gray or malleable iron unless otherwise indicated.
  - 1. Gray Iron: ASTM A 48/A 48M, Class 30.
  - 2. Malleable Iron: ASTM A 47/A 47M.

2.4 COATING MATERIALS

- A. Epoxy Primer for Galvanized Steel: Epoxy primer recommended in writing by topcoat manufacturer.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.

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- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387/C 387M mixed with potable water according to manufacturer's written instructions.
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.6 METALLIC-COATED-STEEL FINISHES

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a zinc-phosphate conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.
- C. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Color: As selected by the Architect from the manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

Construction Documents

3.2 PREPARATION

- A. Stake locations of gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
  - 1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.4 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

END OF SECTION 323119



## SECTION 329300 - LANDSCAPING

### 1.1 GENERAL

- A. The general provisions of Division 1 apply to the work specified in this Section
- B. The work in this Section consists of furnishing all materials, accessories, equipment, tools, transportation and performing all services and labor required to completely execute the fertilizing, liming, seeding, and landscaping work as per the drawings and as herein specified.
- C. Liming, fertilizing, and seeding shall include all disturbed areas and all areas shown on plans.
- D. Location, quantity, and size of all plants shall be as indicated on the drawings.
- E. All materials shall be subject to the approval of the Owner's Representative.
- F. All soil and rubbish resulting from the work to be removed from site.
- G. Contractor shall repair damage of any kind done to the building, parking lot or to the work of other Contractors by the carelessness of his own workmen or otherwise during the progress of work.

### 1.2 JOB CONDITIONS

- A. Before commencing work, this contractor shall verify all conditions at the job. Report any necessary corrections immediately to the General Contractor. Do not proceed until corrections (if any required) are made. Commencing work implies this contractor's acceptance of job conditions.

### 1.3 PLANTS

- A. Plants shall be typical of their species and variety; have normal growth habits; well-developed branches, densely foliated vigorous fibrous root systems, and shall be free from defects and injuries.
- B. Quality and size of plants, spread of roots, and size of balls shall be in accordance with ASA Z60.1-1959, "American Standard for Nursery Stock" as published by the American Association of Nurserymen, Inc.
- C. Plants shall be pruned as specified before planting.

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Construction Documents

- D. Plants shall be freshly dug and nursery grown.
- E. Each bundle of plants and all separate plants shall be properly identified by weatherproof labels securely attached thereto before delivery to project site.
- F. Shrubs shall be well-shaped and full.
- G. All trees must have straight trunks with a single leader intact. Bark shall be free of abrasion; all fresh cuts over 1-1/4 inch shall be calloused over.
- H. Trees will not be accepted which have had their leaders cut or which have leaders damaged so that cutting is necessary.

1.4 DIGGING AND HANDLING

- A. Handle all plants so that roots and foliage are adequately protected at all times.
- B. No plant shall be bound with rope or wire at any time so as to damage the bark, break branches or destroy its natural shape.
- C. Balled, burlapped plants shall come from soil which will hold firm ball.
- D. Container sizes refer to inside diameter of pot. The plants must have been growing in the specified pot for a minimum of three months and a maximum of one year prior to delivery.

1.5 PLANTING TREES AND SHRUBS

- A. Work shall be done under the supervision of an experienced nurseryman approved by the Owner's Representative.
- B. When conditions are such, by reason of drought, high winds, excessive moisture, or other similar factors, that satisfactory results are not likely to be obtained, work shall be stopped. It shall not be resumed until desired results can be obtained or until approved alternate or corrective measures and procedures are adopted.
- C. The depth for excavation of plant pits shall be the depth below finished grade required to accommodate beneath the ball or roots a bed of top soil not less than 6 inches in depth. The ball or roots shall rest on this bed when the plant is properly set to finished grade.
- D. Set all plants plumb and straight. Set at such a level that, after settlement, a



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normal relationship of the crown of the plant with the ground surface will be established. Locate plant in the center of the pit.

- E. When balled, burlapped plants are set, tamp topsoil carefully under and around base of ball to fill all voids. Remove all burlap, ropes, and wires from sides and tops of balls, but do not remove burlap from under ball.
- F. Plant pits and shrub beds shall not be backfilled with topsoil until approved by Owner's Representative.
- G. Backfilling topsoil shall be placed in not more than 6 inches increments of depth between tampings. Water thoroughly at each level with a solution of root stimulant and water.
- H. All planted areas, not including seeded or sod areas, shall receive a permeable fabric weed barrier prior to placing mulch or ground cover.

1.6 GUYING AND STAKING

- A. All guying, staking and wrapping shall be done immediately after planting.
- B. Protect all trees from contact with wires and stakes by sections of rubber hose sufficient length to prevent injury to the tree.
- C. For balled, burlapped plants: Drive stakes into ground outside periphery of ball of tree.
- D. Plants shall stand plumb after staking and guying.
- E. All seals and labels are to remain unbroken and visible on plant material until final inspection. Remove all seals and labels immediately after final inspection.

1.7 PRUNING

- A. Prune in a manner to retain height and spread as given in the Plant List.
- B. Prune in a manner to preserve natural character of plant and in a manner appropriate to its particular requirement in the landscape design.

1.8 GROUND PREPARATION

- A. Not earlier than 24 hours before sod is to be laid, the soil surface to be sodded shall be worked to a depth of not less than two (2) inches with a weighted disc rototiller, pulvimixer, or other equipment approved by the

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Owner's Representative, until the surface is smooth, free from debris, washes, gulleys, clods and stones. If as a result of a rain, the prepared surface becomes eroded or crusted before the sod is to be laid, it shall again be placed in condition for sodding.

1.9 MULCHING

- A. Mulch to be grade shredded hardwood mulch. Apply at least 3" of Mulch to earth saucers and plant beds immediately upon completion of planting. Refer to Section 002900, Paragraph 1.5.I., for weed barrier placement required prior to application of mulch.

1.10 MAINTENANCE AND WATERING

- A. This contractor shall maintain all seeded areas until the seeded areas are established. If necessary, the contractor shall provide netting in addition to mulch and tack in areas that are difficult establish ground cover. The contractor shall fill, re-grade and re-seed any eroded areas greater than 2 square feet in area as quickly as possible after being notified of the defect. If the eroded area(s) are not repaired within one week (seven calendar days), the Owner may have the repairs done by other and deduct the cost of these repairs from monies due the contractor or charge the money against the warranty bond if the repair is done during the warranty period.
- B. Contractor to furnish watering hoses and sprinkling equipment for his use during watering period.

1.11 WARRANTY

- A. The work under this section shall be warrantied for one (1) year from the date of acceptance. Warranty shall cover replacement of unhealthy plants, defects in workmanship and establishment of groundcover. The warranty on any plant or workmanship corrected under the warranty shall extend the warranty for the replaced plant or workmanship for one year from the date of replacement or correction of defects in workmanship.

**-END OF SECTION-**

## SECTION 331200 - WATER PIPING

### 1.1 GENERAL

#### A. Related documents

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
2. Local Department of Transportation Standard Specifications and Details and **Cape Fear Public Utility Authority** specifications and details.
3. Coordinate with Fire Protection Drawings & Specifications.

#### B. Summary

1. This Section includes water line and fire line extensions and water service piping and appurtenances from the source of potable water to a point 1 foot above finished floor inside the building.
2. Related Sections: The following Sections contain requirements that relate to this Section:
  - (1) Division 1 "Testing".
  - (2) Division 2 "Excavation and Backfill" for excavation and backfill required for water service piping and structures.
  - (3) Division 15 Section "Plumbing Systems" for interior building water piping systems and equipment.
3. Products installed but not furnished under this Section include water meters provided by the utility company to the site, ready for installation.

#### C. Submittals

1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
2. Product data for pipes, valves, meter setter yoke, backflow preventers

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Construction Documents

and identification devices.

3. Shop drawings for precast concrete valve pits and meter pit, including frames and covers, also above ground enclosures (if applicable).
4. Record drawings at project closeout of service piping and products in accordance with requirements of Division 1.
5. Maintenance data for valves and backflow preventer, for inclusion in Operating and Maintenance Manuals.
6. Comply with **Cape Fear Public Utility Authority** submittal, record keeping and AS BUILT requirements.

D. Quality Assurance

1. Comply with requirements of the local D.O.T. Standard Specifications and Details and local water utility agency specifications and details.
2. Obtain approval from governing agencies for taps, public waterline extensions and private water line extensions.

E. Delivery, Storage and Handling

1. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use hand wheels or stems as lifting or rigging points.

F. Project Conditions

1. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that water service piping may be installed in compliance with the original design and referenced standards. Notify Owner and Architect of differences between field conditions and plans.

G. Sequencing and Scheduling

1. Coordinate work on public water mains and connection to public water main with governing agencies having authority for water main management.
2. Coordinate service location to building with interior water distribution piping as shown on plumbing plans.
3. Coordinate with other utility work.

Construction Documents

1.2 PRODUCTS

- A. Refer to the site construction drawings for any specifications on pipes and pipe fittings, valves, anchorages, pits and vaults. The more restrictive specifications shall apply.
- B. Pipe and Pipe Fittings, General
  - 1. Pipe and pipe fitting materials shall be compatible with each other. Where more than one type of material or product is indicated, selection is Installer's option.
  - 2. Ductile Iron Pipe 4 inches and larger: AWWA C151, Class 50, except that pipe smaller than 6-inch size shall be Class 51.
  - 3. PVC (Polyvinyl Chloride) Pipe 4 inches and larger: AWWA C900; Class 200; with bell end and elastomeric gasket, with plain end for cast-iron or ductile-iron fittings, or with plain end for PVC elastomeric gasket fittings.
    - (1) Ductile Iron and Cast-Iron Fittings: AWWA C110, ductile-iron or cast-iron, 250-psi pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psi pressure rating; of dimension to match pipe outside diameter.
  - 4. Copper Water Tube 2 Inches and Smaller: ASTM B 88; Type K, seamless, annealed temper.
  - 5. PVC (Polyvinyl Chloride) Pipe 3 Inches and Smaller: ASTM D 1785, Schedule 40.
  - 6. Couplings: Iron body sleeve assembly fabricated to match outside diameters of pipes to be joined.
- C. Valves
  - 1. Non-rising Stem Gate Valves 3 Inches and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, or AWWA C509, resilient seated; bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psi working pressure, mechanical joint ends.
  - 2. Rising Stem Gate Valves, 3 Inches and larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, or AWWA C509, resilient seated; cast-iron or ductile-iron body and bonnet, OS&Y, bronze stem, 200-psi working pressure, flanged ends.

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Construction Documents

3. Non-rising Stem Gate Valves, 2 Inches and Smaller: MSS SP-80; body and screw bonnet of ASTM B 62 cast bronze; with Class 125 threaded ends, solid wedge, non-rising copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing, and malleable iron hand wheel.
4. Valve Boxes: Traffic rated (HS 20) cast-iron box having top section and cover with lettering "WATER", bottom section with base of size to fit over valve and barrel approximately 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury and valve.
5. Curb Stops: Bronze body, ground key plug or ball, and wide tee head, with inlet and outlet to match service piping material.
6. Tapping Sleeve and Tapping Valve: Provide a complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. The sleeve and the valve shall be compatible with the tapping machine to be used.
7. Service Clamps and Corporation Stops: Provide a complete assembly, including service clamp, corporation stop, and bolts and nuts. The clamp and stop shall be compatible with the drilling machine to be used.

D. Anchorages

1. Clamps, Straps, and Washers: ASTM A 506, steel.
2. Rods: ASTM A 575, steel.
3. Rod Couplings: ASTM A 197, malleable iron.
4. Bolts: ASTM A 307, steel.
5. Cast-Iron Washers: ASTM A 126, gray iron.
6. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.

E. Valve Pits, Meter Pit, and Above Ground Vaults

1. Concrete: Portland cement mix, 3000 psi.
2. Reinforcement: Steel conforming to the following:
  - (1) Fabric: ASTM A 185, welded wire fabric, plain.

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- (2) Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- (3) Above ground heated boxes for backflow preventers.
- 3. Ladder: ASTM A 36, steel, or polyethylene-encased cast-iron or steel steps.
- 4. Manhole: ASTM A 48, Class 35, gray iron, 24-inch minimum diameter traffic frame and cover, of size and weight indicated.
- 5. Manhole: ASTM A 536, Grade 60-40-18, ductile iron, 24-inch minimum diameter traffic frame and cover, of size and weight indicated.
- 6. Drain: ANSI A112.21.1M, area drain, cast iron, of size indicated. Traffic rated lids shall be used in all areas. Body shall have anchor flange, light-duty cast-iron grate, and bottom outlet. Drain shall have integral or field-installed bronze ball or clapper-type backwater valve. Above ground vaults shall have positive drainage to the exterior of the vault.
- F. Water Meter: Water meter will be furnished by the Local water utility agency on payment of meter setting fee. Meet Local water utility agency requirements for meter box.
- G. Meter Setter: Meet Local water utility agency requirements for size specified on plans.
- H. Fire Hydrants: Meet Local water utility agency requirements as specified on plans. Provide pipe bollards as shown on the plans. Paint all above ground piping, valves, bollards and hydrants.

1.3 EXECUTION

- A. Refer to the site construction drawings for any specifications on the installation of piping and pipe fittings, valves and anchorages. Also refer to the site drawings for specifications on pipe tests and cleaning. The more restrictive specifications shall apply.
- B. Preparation of Buried Pipe Foundation
  - 1. Refer to Specification Section 312000 – Excavation and Grading, for trench compaction criteria. If rock or unsuitable soils are encountered, all work shall comply with Specification Section 312000.
  - 2. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the piping.

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Construction Documents

3. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or gravel to indicated level.

C. Installation of Pipe and Pipe Fittings

1. Ductile-Iron Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on joint fittings and rubber gaskets in accordance with AWWA C600.
2. PVC (Polyvinyl Chloride) Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on fittings and rubber gaskets in accordance with AWWA M23.
3. Copper Tube: Install with wrought copper, solder joint, pressure fittings, and Sn95 Tin-Antimony solder in accordance with CDA "Copper Tube" Handbook.
4. PVC (Polyvinyl Chloride) Pipe: Install with PVC, Schedule 80 socket-type, solvent cement or elastomeric gasketed fittings in accordance with manufacturer's installation instructions.
5. Depth of Cover: Provide minimum cover over piping of 12 inches below average location frost depth or 36 inches below finished grade, whichever is greater.
6. Water Main Connection: Arrange and pay for tap in water main, of size and in location as indicated, from the Local water utility agency.
7. Water Main Connection: Tap water main with size and in location as indicated, in accordance with requirements of the Local water management agency.
8. Water Service Termination: Terminate water service piping 1 foot above finished floor inside the building in location and invert as indicated. Provide temporary pipe plug for piping extension into building.

D. Installation of Valves

1. General Application: Use mechanical joint end valves for 3-inch and larger buried installation. Use threaded and flanged end valves for installation in pits and inside building. Use bronze corporation stops and valves, with ends compatible to piping, for 2-inch and smaller installation.



Construction Documents

2. AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box.
  3. Bronze Corporation Stops and Curb Stops: Comply with manufacturer's installation instructions. Install buried curb stops with head pointed up.
- E. Installation of Anchorages: Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.
- F. Application of Protective Coatings: Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.
- G. Field Quality Control
1. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have sufficiently hardened. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water. Provide one compaction test for every 100 LF, or part thereof, of line installed.
  2. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours minimum, or as required by local or state agencies.  
  
Increase pressure in 50-psi increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psi. Slowly increase gain to test pressure and hold for one 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 above limits.
  3. Castings shall be wire-brushed or otherwise prepared for painting and painted with a flat black rust inhibitive paint.
- H. Cleaning - Clean and disinfect water distribution piping. Flush and test fire protection lines per fire protection specifications; fire protection engineer to witness flushing of fire lines.
- I. Valve Schedule: Non-rising Stem Gate Valves - 4 Inches and Larger.

**- END OF SECTION -**



## SECTION 333000 - SANITARY SEWERS

### 1.1 GENERAL

- A. Related documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. **Construction shall conform to Cape Fear Public Utility Authority specifications and details.**
- C. Summary: This Section includes sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of connection to public sewer. Connection to the public sewer to be by Contractor, unless sewer agency has that responsibility.
- D. Submittals
  - 1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 2. Product data for drainage piping specialties.
  - 3. Shop drawings for precast concrete sanitary manholes, including frames and covers.
  - 4. Record drawings at project closeout of installed sanitary sewer service piping and products in accordance with requirements of Division 1.
- E. Project Conditions
  - 1. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that sanitary sewerage system piping may be installed in compliance with original design and referenced standards.
- F. Sequencing and Scheduling
  - 1. Coordinate connection to public sewer with **Cape Fear Public Utility Authority**.
  - 2. Coordinate with interior building sanitary drainage piping.
  - 3. Coordinate with other utility work.

Construction Documents

1.2 PRODUCTS

- A. Refer to the site construction drawings for any specifications on pipes and pipe fittings, manholes and cleanouts. The more restrictive specifications shall apply.
- B. Pipe and Fittings
  - 1. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
  - 2. Hub and Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, gray cast iron for compression gasket joints.
  - 3. Hubless Cast-Iron Soil Pipe and Fittings: CISPI 301, gray cast iron, for coupling joints.
  - 4. Ductile-Iron Pressure Pipe: AWWA C151, Class 50, for push-on joints.
  - 5. Ductile-Iron Sewer Pipe: ASTM A 746, Class 50, for push-on joints.
  - 6. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for elastomeric gasket joints.
  - 7. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 1785, Schedule 40 for solvent weld joints.
  - 8. Couplings: Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be jointed.
  - 9. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
- C. Manholes: Precast Concrete Manholes: Use sewer utility agencies having jurisdiction and approval authority standard specifications and details.
- D. Cleanouts: General - Provide cast-iron or Schedule 80 PVC ferrule and countersunk brass cleanout plug. Provide round cast-iron access frame and heavy-duty, secured, scored cast-iron cover in paved areas with a concrete apron (18" x 18" x 12" deep).

Construction Documents

1.3 EXECUTION

- A. Refer to the site construction drawings for any specifications on the installation of sanitary sewer piping, pipe joints, manholes, cleanouts and tap connection. Also refer to the site drawings for specifications on pipe testing and cleaning. The more restrictive specifications shall apply.
- B. Preparation of Foundation for Buried Sanitary Sewerage Systems
  - 1. Refer to Specification Section 312000- Excavation and Grading, for trench compaction criteria. If rock or unsuitable soil are encountered, all work shall comply with Specification Section 312000.
  - 2. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
  - 3. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or gravel to indicated level.
- C. Pipe Applications for Underground Sanitary Sewers
  - 1. Pipe sizes 4 to 54 inches: Ductile-iron sewer pipe.
  - 2. Pipe sizes 15 inches and smaller: PVC gasket joint sewer pipe and fittings; AWWA C-900.
  - 3. Pipe sizes 6 inches and smaller: PVC solvent cement joint sewer pipe and fittings; ASTM D 17858, Schedule 40.
- D. Installation, General
  - 1. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical. Prior to any rerouting, obtain Owner's approval.
  - 2. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.
  - 3. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated.

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Construction Documents

E. Pipe Joint Construction and Installation

1. Join and install ductile-iron pipe with ductile-iron or cast-iron push-on joint fittings and rubber gaskets in accordance with AWWA C600, except that anchorages are not required.
2. Join and install PVC pipe as follows:
  - (a) Solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D 2855 and ASTM F 402.
  - (b) Pipe and gasketed fittings, joining and elastomeric seals in accordance with ASTM D 3212.
  - (c) Installation in accordance with ASTM D 2321.
3. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

F. Manholes

1. General: Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channels and benches between inlets and outlets. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 1 foot above finish surface, unless otherwise indicated.
2. Construct cast-in-place manholes as indicated.
3. Castings shall be wire-brushed or otherwise prepared for painting and painted with a flat black rust inhibitive paint.

G. Cleanouts

1. Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 12" by 12" by 6" inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving.
2. Castings shall be wire-brushed or otherwise prepared for painting and painted with a flat black rust inhibitive paint.

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Construction Documents

H. Tap Connections

1. Make connections to existing piping and underground structures piping that is indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

I. Field Quality Control

1. Testing: Perform testing of completed piping and manholes in accordance with **Cape Fear Public Utility Authority** requirements. See Section 312000 and Division 1 for testing requirements. Perform one compaction test for every 100 LF, or part thereof, of line installed and under each structure. Perform compaction testing for every 8" lift of backfill in trench and under structure.
2. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
3. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred. Test all lines between manholes using a mandrill of the size specified by the local jurisdiction having authority.

- END OF SECTION -





## SECTION 334100 - STORM SEWERS

### 1.1 General

- A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections: 312000 – Excavation and Grading.
- C. Summary: This Section includes storm sewerage system piping and appurtenances from a point 5 feet outside the building to the point of discharge or connection to existing storm sewer.
- D. Submittals
  - 1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
  - 2. Product data for drainage piping specialties.
  - 3. Shop drawings for precast concrete storm drainage manholes and catch basins, including frames, covers, and grates.
- E. Project Conditions: Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.
- F. Sequencing and Scheduling
  - 1. Coordinate with interior building storm drainage piping.
  - 2. Coordinate with other utility work.

### 1.2 Products

- A. Pipe and Fittings
  - 1. General: Provide pipe and pipe fitting materials compatible with each other.
  - 2. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D1785, PVC pipe, schedule 40.
  - 3. Reinforced Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for mastic joints.
  - 4. Non-reinforced Concrete Sewer Pipe and Fittings: ASTM C 14, Class 2, for mastic joints.

Construction Documents

B. Manholes

1. Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated.
2. Cast-in-Place Manholes: Reinforced concrete of dimensions and with appurtenances indicated.
  - (1) Bottom, Walls, and Top: Reinforced concrete.
  - (2) Channel and Bench: Concrete.
  - (3) Steps: Cast into sidewall at 12- to 16-inch intervals.
3. Manhole Steps: 12 inch wide cast iron, galvanized steel or steel encased in corrosion resistant material (rubber or plastic).
4. Manhole Frames and Covers: Heavy-duty traffic bearing, cast iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover, indented top design, with lettering "STORM SEWER" cast into cover.

- C. Cleanouts: Provide cast-iron or schedule 80 PVC ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

D. Catch Basins

1. Precast Concrete Catch Basins: ASTM C 478 or ASTM C 858, precast reinforced concrete, of depth indicated. Sections shall have provision for rubber gasket joints. Base section slab shall have minimum thickness of 6 inches, riser sections shall have minimum thickness of 4 inches and be 48 inches inside diameter, and top section and grade rings shall match 24-inch frame and grate, unless otherwise indicated.
2. Cast-in-Place Catch Basins: Reinforced concrete of dimensions and with appurtenances indicated.
  - (1) Bottom, Walls, and Top: Reinforced concrete.
  - (2) Channel and Bench: Concrete.
3. Catch Basin Steps: 12 inch wide cast iron, galvanized steel or steel encased in corrosion resistant material (rubber or plastic).
4. Catch Basin Frames and Grates: ASTM A 536 Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate having small square or short slotted drainage openings.

Construction Documents

5. Curb Inlets: Precast concrete of dimensions conforming to utility standards.

E. Concrete and Reinforcement

- a. Concrete: Portland cement mix, 3,500 psi.
- b. Reinforcement: Steel conforming to the following:
  - (1) Fabric: ASTM A 185, welded wire fabric, plain.
  - (2) Reinforcement Bars: ASTM A 615, Grade 60, deformed.

1.3 Execution

A. Preparation of Foundation for Buried Storm Sewer Systems

1. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
2. Remove unstable, soft, or unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand, pea gravel or crushed stone (100% passing 1-1/2" sieve and 0-5% passing a No. 50 sieve) to indicated level.

B. Pipe Applications for Underground Storm Sewers

1. Pipe sizes 12 inches and Larger: Reinforced concrete sewer pipe and fittings.
2. Pipe sizes smaller than 12 inches: PVC sewer pipe or non-reinforced concrete sewer pipe.

C. Installation, General

1. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground storm sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
2. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
3. Extend storm sewerage system piping to connect to building storm drains, of sizes and in locations indicated.

D. Pipe and Tube Joint Construction and Installation

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Construction Documents

1. Join concrete pipe and fittings with mastic in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual."

**E. Manholes**

1. General: Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channel and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 1 inch above finish surface, unless otherwise indicated.
2. Construct cast-in-place manholes as indicated.
3. Apply bituminous mastic coating at joints of sections.

**F. Cleanouts**

1. Install cleanouts and extension from sewer pipe to clean out at grade as indicated. Set cleanout frame and cover in concrete pad 12"x 12"x 6" deep (minimum), except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving. Coordinate with section 02730 G.
2. Castings shall be wire-brushed or otherwise prepared for painting and painted with a flat black rust inhibitive paint.

**G. Catch Basins**

1. Construct catch basins to sizes and shapes indicated.
2. Set frames and grates to elevations indicated.

**H. Tap Connections**

1. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
2. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large 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 structure 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.

Construction Documents

3. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

I. Field Quality Control

1. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction. See Division 1 for testing requirements. Perform one compaction test for every 100 LF, or part thereof, of line installed and under each structure. Perform compaction testing for every 8" lift of backfill in trench and under structure.
2. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
3. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
4. Castings shall be wire-brushed or otherwise prepared for painting and painted with a flat black rust inhibitive paint.

**-END OF SECTION-**



Construction Documents

SECTION 334600 - SUBDRAINAGE

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. Perforated-wall pipe and fittings.
  - 2. Drainage conduits.
  - 3. Drainage panels.
  - 4. Geotextile filter fabrics.

1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Drainage conduits, including rated capacities.
  - 2. Drainage panels, including rated capacities.
  - 3. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings:
  - 1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
  - 2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
  - 3. Couplings: Manufacturer's standard, band type.

Construction Documents

2.2 DRAINAGE CONDUITS

- A. Molded-Sheet Drainage Conduits: Prefabricated geocomposite with cusped, molded-plastic drainage core wrapped in geotextile filter fabric.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Wick Drain.
    - b. JDR Enterprises, Inc.
    - c. TenCate Geosynthetics.
  - 2. Nominal Size: 12 inches high by approximately 1 inch thick.
    - a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716, unless otherwise required.
  - 3. Filter Fabric: PP geotextile.
  - 4. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
- B. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350 and wrapped in geotextile filter fabric.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Advanced Drainage Systems, Inc.
  - 2. Nominal Size: 12 inches high by approximately 1 inch thick.
    - a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716, unless otherwise indicated.
  - 3. Filter Fabric: PP geotextile.
  - 4. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
  - 5. Couplings: Corrugated HDPE band.

2.3 DRAINAGE PANELS

- A. Molded-Sheet Drainage Panels: Prefabricated geocomposite, 36 to 60 inches wide with drainage core faced with geotextile filter fabric.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide “Hydrocut 220” by GCP Applied Technologies Inc., (previously W.R. Grace Construction Products,) or a comparable product by one of the following:
    - a. American Wick Drain.
    - b. Cosella-Dörken Products, Inc.
    - c. Eljen Corporation.



Construction Documents

- d. JDR Enterprises, Inc.
  - e. Midwest Diversified Technologies Incorporated.
  - f. Sika Greenstreak.
  - g. TenCate Geosynthetics.
  - h. Trace-LINQ Inc.
2. Drainage Core: Three-dimensional, nonbiodegradable, molded PP.
- a. Minimum Compressive Strength: 18,000 lbf/sq. ft. when tested according to ASTM D 1621.
  - b. Minimum In-Plane Flow Rate: 7 gpm/ft. of unit width at hydraulic gradient of 1.0 and compressive stress of 25 psig when tested according to ASTM D 4716.
3. Filter Fabric: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288:
- a. Survivability: Class 2.
  - b. Apparent Opening Size: No. 60 sieve, maximum.
  - c. Permittivity: 0.2 per second, minimum.
4. Film Backing: Polymeric film bonded to drainage core surface.

2.4 WATERPROOFING FELTS

- A. Material: Comply with ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-saturated organic felt.

2.5 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.
- B. Structure Type: Nonwoven, needle-punched continuous filament.
  - 1. Survivability: AASHTO M 288 Class 2.
  - 2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

Construction Documents

- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 FOUNDATION DRAINAGE INSTALLATION

- A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.
- F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.
- H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- J. Install drainage panels on foundation walls as follows:
  - 1. Coordinate placement with other drainage materials.
  - 2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.

Construction Documents

3. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end of remaining core.
  4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.
- K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
1. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches unless otherwise indicated.
  2. Lay perforated pipe with perforations down.
  3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install thermoplastic piping according to ASTM D 2321.

3.5 PIPE JOINT CONSTRUCTION

- A. Join perforated PE pipe and fittings with couplings according to ASTM D 3212 with loose banded, coupled, or push-on joints.
- B. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.6 CLEANOUT INSTALLATION

- A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."
- B. Cleanouts for Foundation Subdrainage:
1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

Construction Documents

2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches deep. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches deep. Set top of cleanout 1 inch above grade.

3.7 CONNECTIONS

- A. Connect low elevations of subdrainage system to building's solid-wall-piping storm drainage system.

3.8 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600



July 1 2020  
JOB: HTW

**The Healing Place of New Hanover County  
1000 Medical Center Drive  
Wilmington, North Carolina**

**CAPE FEAR PUBLIC UTILITY AUTHORITY SPECIFICATIONS**

- 01 30 00 CFPUA Pre-Con Checklist
- 01 30 00 Administrative Requirements
- 01 33 00 Submittals
- 01 35 00 Special Procedures
- 01 40 00 Quality Requirements
- 01 60 00 Product Requirements
- 01 70 00 Execution and Closeout Requirements
- 02 41 00 Demolition
- 02 82 13 Asbestos Abatement for Utilities
- 31 23 34.01 Excavating, Trenching, Dewatering and Backfilling for Utility Work
- 33 01 12 Identification for Utility Piping
- 33 01 30.86 Manhole Rim Adjustment
- 33 05 05.31 Hydrostatic Testing
- 33 05 07.23 Jacking and Boring
- 33 05 09.33 Thrust Restraint for Utility Piping
- 33 05 13 Precast Concrete Manholes and Utility Structures
- 33 14 13 Water Distribution Piping
- 33 14 14 Public Water Service Connections
- 33 14 20 Disinfection of Water Pipelines and Appurtenances
- 33 14 22 Testing of Sanitary Sewer Mains and Manholes
- 33 31 11 Sanitary Sewer Gravity Mains

**CAPE FEAR PUBLIC UTILITY AUTHORITY MATERIALS**

- Section A Pipe
- Section B Fittings and Accessories
- Section C Joint Restraints
- Section D Valves and Accessories
- Section E Fire Hydrants
- Section F Service Saddles and Tapping Devices
- Section G Brass Service Materials
- Section H Repair Sleeves Coupling Clamps & Non-Pressure Adapters
- Section I Castings and Access Covers
- Section J Service Boxes
- Section K Miscellaneous
- Section L Electrical
- Section M Coatings and Sealants
- Section N Concrete
- Section O Structures

The SITE Group  
1111 Oberlin Road  
Raleigh NC 27605



### CFPUA PRE-CON CHECKLIST

- 1. CFPUA Technical Specifications, Material Specification Manual and Details must be followed.
- 2. For scheduling purposes, the contractor must give two business days' notice (by e-mail) to the assigned CFPUA inspector (the exact date will be determined by the CFPUA Inspector and CFPUA Operations schedule) for each of the following:
  - When construction begins
  - Operating any CFPUA valve (including tapping, tie-in, fire line or service valves)
  - If the contractor pulls off the site for more than two (2) weeks
  - Installing a sewer main out of a tie-in to an existing manhole
  - Cutting in a new manhole on an existing line
  - Coring an existing manhole
  - Tapping an existing sewer main, water main or force main.
  - Any bores and threading carrier pipes
  - All camera work, testing, chlorination and water sampling
  - Setting up or operating a sewer by-pass
- 3. The contractor is to notify the Design Engineer with any request to deviate from the CFPUA approved For Construction stamped plans. The Design Engineer will then notify the CFPUA Project Manager for review and final approval by CFPUA. The design engineer and CFPUA must approve the deviation prior to work beginning.
- 4. Any changes to CFPUA details must be approved by the CFPUA Project Manager. These changes will be noted/clouded on CFPUA Detail Sheet.
- 5. Notify the CFPUA Inspector when material is delivered to the job site for verification that materials meet CFPUA Technical Specifications, Material Specification Manual or approved submittal.
- 6. No CFPUA valve shall be operated without a CFPUA Inspector or CFPUA Water Quality employee present.
- 7. Any work after normal working hours (Monday – Friday 7:00 AM – 3:30 PM) must be pre-approved and scheduled with the CFPUA Project Manager and Inspector. An “After Hours Inspection Fee” will be charged unless after hours work is required by CFPUA.
- 8. All shutdowns must be pre-approved and scheduled with the CFPUA Project Manager and Inspector. They will coordinate with the proper CFPUA departments. Shutdowns on critical lines will require a pre-shutdown meeting. Additional information and pre-inspection of material will be required.
- 9. No cutting in of manholes on existing sewer, water or sewer force main tie-ins or shutdowns will be made on Friday thru Monday unless pre-approved by CFPUA Operations.
- 10. It is the Contractor's responsibility to request CFPUA Standard Operating Procedures for items not covered in the Technical Specifications, Material Specification Manual and Details (i.e. abandoning infrastructure, work on older materials, shut down procedures, coring locations in manholes).

- 11. For meters 3” or greater, when the meter vault installation is approved and the main/service line is certified and activated (if permitted), the CFPUA Inspector will send an email to the Developer, Builder, Contractor and CFPUA Meter Services that a “Large Meter Set Installation Appointment” can be requested. The contractor will call (910)332-6550 to make the request two business days in advance.
- 12. It is the Contractor’s responsibility to verify that corporation stops or valves are open on all services
- 13. Boring and Jacking
  - Approved “Boring and Jacking Plan” per CFPUA SPECS (33 05 07.23).
  - Approved pipe (mechanical or restrained joints) to be used when main is to be operating under pressure per CFPUA SPECS (33 05 07.23 and 33 05 09.33).
- 14. Sewer Bypass Pumping (CFPUA Spec 01 51 00)
  - Must submit and have approved a “Bypass Pumping Plan” per CFPUA SPECS (01 51 00 1.4).
  - All bypass pumping operations must be monitored 24 hours / 7 days a week.
  - Monitoring person must be properly trained, experienced and mechanically qualified.
- 15. In the event of a water/sewer main line or service break, the CFPUA Emergency number (910-332-6565) will be called immediately. Then, the CFPUA Inspector will be notified to assist in obtaining the proper response, if any, from CFPUA.
- 16. In the event an acceptance test, i.e. hydro test, bac-t sample, chlorination, air, vacuum ... has to be repeated at no fault of CFPUA a “Water/Sewer Line Acceptance Testing Reinspection” fee will apply. If the testing is after normal working hours (Monday – Friday 7:00 AM – 3:30 PM) a “Water/Sewer Line Acceptance Testing Reinspection – After Hours Fee” will apply.
- 17. Shrubs, bushes, trees and similar vegetation shall be planted in a manner that will provide a minimum of three feet unrestricted access from the meter box and clean-out to the road. No shrubs, bushes, or trees shall be planted within three feet around the meter box or clean-out that may hinder Authority’s ability to maintain infrastructure. Small (less than 18” diameter and height), shallow rooted or seasonal planting may be approved within three feet of the meter box or cleanout, provided that these plantings do not hinder the Authority’s ability to access and maintain the infrastructure at the planting’s mature growth.
- 18. As built and CCTV inspections are completed in the order that they are received. The typical review time is generally ten (10) to fifteen (15) business days for CCTV and five (5) to twenty (20) business days for as-built’s but will depend on the complexity of the project, size and quality of the submittal.
- 19 Provide a minimum of six (6) inches of separation between edge of manhole core holes and manhole barrel joints. Provide a minimum of six (6) inches separation between edges of core holes. Coring the manhole cone section is not allowed. All manhole main line and service piping shall be installed at a minimum of crown to crown of the largest diameter pipe.
- 20 Prior to the contractor scheduling a tap inspection the following items must be completed:
  - All CFPUA fees must be paid.
  - A copy of the NCDOT encroachment agreement or City of Wilmington Street Cut permit must be sent to the CFPUA Construction Project Manager.
  - If an encroachment or street cut permit is not required, an email from the owner of the right of way stating such must be sent to the CFPUA Construction Project Manager.





Engineering Department  
235 Government Center Drive  
Wilmington, NC 28403  
Phone: (910) 332-6560  
Fax: (910) 332-6353  
[www.cfpu.org](http://www.cfpu.org)

- 21. Failure to comply with any of the above-mentioned items shall result in CFPUA Community Compliance issuing a Notice of Violation for failure to comply.

\_\_\_\_\_  
Project Name

\_\_\_\_\_  
CFPUA File #

\_\_\_\_\_  
Contractor Signature (required)

Date: \_\_\_\_\_

\_\_\_\_\_  
CFPUA Project Manager/Project Engineer Signature

Date: \_\_\_\_\_



SECTION 01 30 00  
ADMINISTRATIVE REQUIREMENTS  
(DEVELOPMENT PROJECTS)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting (CFPUA Pre-Con Checklist Attached).
- C. Progress meetings.
- D. Preinstallation meetings.
- E. Inspections.
- F. Testing and Gravity Sewer Video.
- G. Closeout Documentation.
- H. Final Construction Completion

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.

1.3 PRECONSTRUCTION MEETING

- A. A pre-construction conference is required for every development project that requires the construction of water and/or sewer facilities.

- B. The pre-construction meeting must be scheduled through the CFPUA construction Manager with at least two (2) business day notice.
- C. Pre-construction meeting can be held after receipt of all applicable permits, approval of the final construction drawings and material shop drawings, verification of contractor licensing and payment of all outstanding fees.
- D. Attendance Required: Engineer, Owner or Owner's representative, Licensed Utility Contractor, major Subcontractors, and CFPUA Project/Construction Managers.
- E. Minimum Agenda:
  - 1. Discuss the approved drawings;
  - 2. Discuss the general construction sequence and schedule;
  - 3. Review general construction inspection procedures and requirements;
  - 4. Discuss lines of communication;
  - 5. Discuss typical project pitfalls and time savers;
  - 6. Discuss project challenges. The contractor is encouraged to review the project ahead of the pre-con, ask for clarifications, and introduce any particular challenges that he/she anticipate in the construction of the project.
  - 7. Other topics per the pre-con checklist.
- F. At the end of the pre-construction meeting, the developer will receive a copy of the sign in sheet, signed pre-construction checklist, stamped approved construction plans and specifications.

#### 1.4 PROGRESS MEETINGS

- A. Schedule and administer meetings through progress of the Work.
- B. Make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.
- C. Attendance Required: Job Superintendent, major Subcontractors, Engineer or Owner's Representative, CFPUA Inspector and CFPUA Project/Construction Manager, as appropriate to agenda topics for each meeting.
- D. Minimum Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems impeding planned progress.
  - 5. Review of submittal schedule and status of submittals.
  - 6. Review of off-site fabrication and delivery schedules.
  - 7. Maintenance of Progress Schedule.
  - 8. Planned progress during succeeding work period.
  - 9. Coordination of project progress.
  - 10. Maintenance of quality and work standards.
  - 11. Effect of proposed changes on Progress Schedule and coordination.
  - 12. Other business relating to Work.

## 1.5 PREINSTALLATION MEETINGS

- A. When required in individual Specification Sections, convene preinstallation meetings at Project Site before starting Work of specific Section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific Section.
- C. Notify Engineer and CFPUA Project/Construction Manager four days in advance of meeting date.
- D. Prepare agenda and preside over meeting:
  - 1. Review conditions of installation, preparation, and installation procedures.
  - 2. Review coordination with related Work.
- E. Record minutes and distribute copies to participants within two days after meeting.

## 1.6 INSPECTIONS

- A. Material Inspection
  - 1. Before any work is started on the project, the Contractor shall make submittals to the Engineering in accordance with the requirements of CFPUA Specification Section 01 33 00, Submittals. The CFPUA Inspector shall be notified when any material is delivered to the job site.
  - 2. The CFPUA Inspector will verify that all materials meet CFPUA specifications, details, and/or approved submittal.
  - 3. The CFPUA Inspector will notify the Contractor and the CFPUA Construction Manager of any unapproved material, and that the unapproved material must be removed from the project site.
- B. General Inspection
  - 1. Routine and unscheduled of ongoing projects will be made by CFPUA personnel during the construction phase to ensure conformance with the approved plans, CFPUA specifications and details, as well as compliance with this guidance manual.
  - 2. Projects approved for construction by the CFPUA automatically authorizes CFPUA inspection personnel access to the construction site at all times for the purpose of inspecting constructed facilities or observing construction operations in progress. CFPUA Inspectors will take appropriate action, as outlined herein, when improper material or unacceptable workmanship is detected on the project and will notify the CFPUA Construction Manager, Contractor, Engineer and/or Developer.
  - 3. CFPUA Inspectors shall make periodic checks during all phases of construction to ensure that the contractor is complying fully with project design and specifications including:
    - a. CFPUA valves are not to be operated without a CFPUA Inspector or CFPUA Water Quality personnel present (Notice of Violations will be given if failure to comply).

- b. Any work after normal working hours (Monday – Friday 7:00 AM – 3:30 PM) must be pre-approved and scheduled with the CFPUA Construction Manager and Inspector.
- c. All shut downs must be pre-approved and scheduled with the CFPUA Construction Manager and Inspector (they will coordinate with the proper CFPUA departments).
- d. Water or sewer force main tie-ins or shut downs will not be conducted on Friday through Monday unless pre-approved by CFPUA Operations.
- e. Contractor is to give two (2) business days notification for scheduling to the assigned CFPUA Inspector for each of the following:
  - 1) Operating any CFPUA valve (includes tapping valves).
  - 2) When beginning construction and if the contractor pulls off the site.
  - 3) Laying out of any connection in existing manholes.
  - 4) Cutting in any new manholes on existing lines.
  - 5) Coring any manholes.
  - 6) Connecting onto existing sewer force mains.
  - 7) Connecting onto existing water lines.
  - 8) Any bores and threading carrier pipes.
  - 9) All camera work, testing, chlorination and water sampling.
  - 10) All testing.

## 1.7 TESTING AND GRAVITY SEWER VIDEO

All structures, pressure piping and gravity sewer piping shall be tested by the contractor as specified in the CFPUA Specifications in accordance with applicable regulations and as directed by the CFPUA Inspector. All testing must be conducted in the presence of the CFPUA Inspector. The Contractor is to give two (2) business days notification for scheduling, to the assigned CFPUA Inspector for all testing.

## 1.8 CLOSEOUT DOCUMENTATION

A. The purpose of the as-built record drawings is to verify that the water and sewer system serving the project were installed per CFPUA Technical Specifications, in accordance with the approved construction permit, and recorded to show the actual locations of the water and sewer assets to be conveyed to CFPUA for ownership, operation and maintenance.

### B. Paper As-built Drawings

Two (2) sets of as-built record drawings shall be provided in accordance with CFPUA Specification Section for review. The as-built checklist and an example of the plan's cover sheet are provided in the CFPUA Development Process and Procedures manual. It shall be the engineer's responsibility to assure that the most current as-built checklist is used and to check the as-builts for conformance with this checklist before submitting the as-builts.

### C. Plans and Checklist

Certified, surveyed record drawings (as-built plans), sealed by a North Carolina licensed Professional Land Surveyor or Professional Engineer (engineer seal required)

for profiles), shall be furnished to CFPUA by the Engineer of Record (or Developer, where applicable) prior to completion and acceptance of the infrastructure by CFPUA. The as-built plans shall conform to the as-built checklist.

D. As-built Submission

Two (2) sets of as-built record drawings shall be submitted to the CFPUA Inspector.

1. Sewer projects – Prior to the review of the camera inspection of the installed infrastructure.
2. Water projects – After the infrastructure has been installed and pressure testing and disinfection has been completed and approved by CFPUA.

E. CFPUA Inspector's Review

The CFPUA Inspector will review the as-built drawings for compliance with the CFPUA As-built Checklist. The CFPUA Inspector will field verify the location of all water and sewer items on the as-builts. Comments will be provided to the contractor and engineer.

F. Final Sealed As-Built Drawings

Once the CFPUA Inspector approves the as-built drawing, a final copy is to be submitted on original base Mylar sheets (24" X 36"). A PDF and digital copy must be provided to CFPUA. Final Sealed as-built drawings must be submitted per the CFPUA Development Process and Procedures manual.

1.9 FINAL CONSTRUCTION COMPLETION

A. Items Required for Completion

Construction is considered complete when the following items are successfully satisfied:

1. Testing (hydro, water samples, air, vacuum, mandrel, and pump station).
2. As-Built Drawings.
3. Camera Inspection (gravity sewer).
4. Walk through acceptance inspection.

- B. Once complete, the project is ready to move toward certification and conveyance.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION





SECTION 01 33 00  
SUBMITTALS  
(DEVELOPMENT PROJECTS)

PART 1 GENERAL

1.1 DESCRIPTION

- A. Definitions.
- B. Submittal procedures.
- C. Use of electronic CAD files of Project Drawings.
- D. Shop Drawings.
- E. Certificates.
- F. Manufacturer's instructions.
- G. Manufacturer's field reports.
- H. Contractor review.
- I. Engineer review.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect/Engineer's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 CONSTRUCTION PROGRESS SCHEDULE

- A. At Preconstruction Meeting, submit proposed complete bar chart schedule for review.
- B. Submit updated schedules at monthly progress meetings.
- C. Schedule Updates:
  - 1. Overall percent complete, projected and actual.
  - 2. Completion progress by listed activity and subactivity, to within five working days prior to submittal.
  - 3. Changes in Work scope and activities modified since submittal.
  - 4. Delays in submittals or resubmittals, deliveries, or Work.
  - 5. Adjusted or modified sequences of Work.

6. Other identifiable changes.
  7. Revised projections of progress and completion.
- D. Narrative Progress Report:
1. Submit with each monthly submission of Progress Schedule.
  2. Summary of Work completed during the past period between reports.
  3. Work planned during the next period.
  4. Explanation of differences between summary of Work completed and Work planned in previously submitted report.
  5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
  6. Corrective action taken or proposed.

#### 1.4 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer-accepted form.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver to Engineer at business address or submit electronic submittals via email as PDF electronic files. Coordinate submission of related items.
- F. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- G. Allow space on submittals for Contractor and Engineer review stamps.
- H. When revised for resubmission, identify changes made since previous submission.
- I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- J. Submittals not requested will not be recognized nor processed.
- K. Incomplete Submittals: CFPUA will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of CFPUA.

#### 1.5 SHOP DRAWINGS

- A. Shop Drawings: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
  - 1. Include signed and sealed calculations to support design.
  - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
  - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submittals
  - 1. Submit number of opaque reproductions Contractor requires, plus one copy Engineer will retain, or
  - 2. Submit electronic submittals via email as PDF electronic files.
- E. After review, produce copies and distribute.

#### 1.6 CERTIFICATES

- A. Informational Submit: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, and CFPUA in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer and CFPUA.

#### 1.7 MANUFACTURER'S INSTRUCTIONS

- A. Submit manufacturer's installation instructions for Engineer's and CFPUA knowledge.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer and CFPUA in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

#### 1.8 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Engineer's knowledge as Contract administrator or for Owner and CFPUA's knowledge.

- B. Submit report in duplicate within 5 days of observation to Engineer and CFPUA for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

### 1.9 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
  - 1. Determination and verification of materials including manufacturer's catalog numbers.
  - 2. Determination and verification of field measurements and field construction criteria.
  - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
  - 4. Determination of accuracy and completeness of dimensions and quantities.
  - 5. Confirmation and coordination of dimensions and field conditions at Site.
  - 6. Construction means, techniques, sequences, and procedures.
  - 7. Safety precautions.
  - 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from CFPUA.

### 1.10 ENGINEER REVIEW

- A. Informational submittals and other similar data are for Architect/Engineer's information, do not require Architect/Engineer's responsive action, and will not be reviewed or returned with comment.
- B. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- C. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order or Work Change Directive.
- D. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.

## PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION



SECTION 01 35 00

SPECIAL PROCEDURES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Pre-Construction Audio/Video Inspections and Photography
- B. Safety Plan
- C. Work Along Streets, Highways, and Railroads
- D. Notification to Local Residents Impacted by Work
- E. Protection of Work and Property
- F. Responsibility for Damage
- G. CFPUA Water Supply and Backflow Prevention
- H. NCDEQ Minimum Separation of Water and Sewer Facilities
- I. Restoration of Disturbed Areas
- J. Regulatory Enforcement Actions Imposed

1.2 PRE-CONSTRUCTION AUDIO-VIDEO INSPECTIONS AND PHOTOGRAPHY

- A. The Contractor shall be responsible for performing and submitting audio-video (AV) inspections and photographs of the project areas prior to performing any Work. AV inspections and photographs shall clearly document preconstruction conditions at all proposed Work locations. AV inspections and photography work shall be considered incidental to the contract.
- B. The purpose of the AV inspections and photographs shall be to document the pre-construction conditions for comparison with the final restored Work. If Engineer, Owner, or third-party claims damage or deficient restoration in a Work area that cannot be disproved by preconstruction AV inspections and photographs, then Contractor shall be responsible for repairs or additional restoration at no additional cost, and as necessary to resolve the claim.
- C. The AV inspection shall be submitted in an electronic format accompanied with the following:
  - 1. Data stored on USB flash drive
  - 2. Map of overall work area showing;
    - a. AV sequence and direction of travel
    - b. AV elapsed time by location at no greater than 5 minute intervals

### 1.3 SAFETY PLAN

- A. The Contractor shall prepare a detailed Safety Plan. This plan shall indicate the intended procedures to be used by the Contractor to comply with all OSHA requirements. Such Plan should further identify a competent person that will work with each crew. Safety plan shall be available for review at the job site at all times.

### 1.4 WORK ALONG STREETS, HIGHWAYS AND RAILROADS

- A. Traffic Control and Maintenance:
1. The proposed work may be performed within rights-of-way or easements as follows:
    - a. NC Department of Transportation public streets and roads
      - 1) Encroachment agreement obtained by Engineer/Owner
    - b. City of Wilmington public streets and roads
      - 1) Encroachment permit obtained by Contractor
    - c. CSX rights-of-way
      - 1) Encroachment permit obtained by Engineer/Owner
    - d. Dedicated utility rights-of-way or easements
      - 1) Encroachment obtained by Contractor/Owner
  2. Contractor shall adhere to the bounds as set forth in all rights-of-way and easements unless prior written approval of the current property owner is obtained and submitted to the Engineer and State, City, and local utility authorities for approval.
  3. Contractor shall submit a traffic control plan for approval by NCDOT or City of Wilmington in accordance with the respective encroachment agreement. When feasible, at least one lane of traffic will be safely maintained at all times when construction is in progress, otherwise, a detour plan must be submitted and approved with the traffic control plan.
  4. Traffic will be maintained on all streets or private drives throughout the work. All matters related to traffic maintenance must be done in a manner consistent with the Manual on Uniform Traffic Control Devices, City of Wilmington Traffic Standards and/or the NCDOT's "Uniform Traffic Control Devices". No roads shall be closed for construction activities unless approved otherwise.
  5. Access to businesses and residences along the roads shall be maintained at all times. All lanes will be open when work is suspended for three hours or longer. Warning signs and devices will be placed in advance of all construction activity in accordance with the most recent copy of the Manual on Uniform Traffic Control Devices, the City of Wilmington Traffic Standards and the North Carolina Department of Transportation's "Uniform Traffic Control Devices".
  6. The Contractor shall provide all appropriate signing and barricades and shall provide flag persons at all times and places necessary.
  7. Traffic control will be strictly enforced in order to provide fire and police protection to the area and access to drives while construction is in progress.
  8. In the event of a necessary road or driveway closure, occupants and/or property owners must be notified a minimum of two business days in advance to any private drive closings.
  9. Where businesses have only one means of access, the Contractor shall provide an alternative means of access or perform work during hours when the business is closed.



10. Property owners and surrounding residents will be provided an additional notice if work is to extend outside normal business hours.
  11. For projects requiring City of Wilmington right-of-way permit, the Contractor is always required to keep a copy of the permit at the construction site .
  12. The Contractor will notify CFPUA two business days prior to commencing any construction within any right-of-way or easement.
- B. Installation of Pipe Under Streets, Highways and Railroads:
1. The Contractor shall furnish and install protective steel pipe casings and/or carrier pipe under highways/railroads in the pipe size, thickness, length, location and details as shown on the drawings and specified herein.
  2. The construction shall not be started until the necessary permits have been obtained, a copy is at the job site, and proper notice and approval for construction has been obtained from the owner of the street/highway/railroad and the Engineer.
  3. All necessary materials, equipment, labor and traffic protection devices shall be on the job site before starting the Work.
  4. Steel casings and the installation thereof required for street/highway/railroad crossings shall be in accordance with the permitted standards and requirements of the City of Wilmington, NCDOT, or CSX Railroads.

#### 1.5 NOTIFICATION TO LOCAL RESIDENTS IMPACTED BY WORK

- A. The Contractor shall provide work schedules, traffic control plans, and other information needed for accurate notifications to local residents of construction activity area. The Contractor shall coordinate with CFPUA, NCDOT and the City of Wilmington to provide public notifications within seven (7) days prior to beginning work in an area. CFPUA shall be responsible for issuing public notification to the media when necessary. Contractor shall be responsible for placing door hangars in advance of scheduled work. Copies of door hangars to be distributed to local residents shall be submitted to the CFPUA Project Manager for approval prior to distribution.

#### 1.6 PROTECTION OF WORK AND PROPERTY

- A. Property Monuments: The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed. Any property monuments, iron pins, etc., disturbed by the Contractor's actions will be restored at the Contractor's expense. Only licensed land surveyors will be utilized to restore property monuments, etc.
- B. Clearing: To lessen the impact to adjacent property owners, the Contractor will submit a request to the Engineer and Owner for any clearing activities. Only the area required for access and Work will be cleared, as approved by the Engineer and CFPUA.
- C. Protection of Shallow Buried Pipelines: The Contractor shall protect the integrity of all shallow public and private utility mains at all times, via approved resources such as

wood road mats, crane mats, PE mats, road plates, etc, to be installed prior to the beginning of work. The approved protection method shall be maintained during and properly removed at the end of the Work.

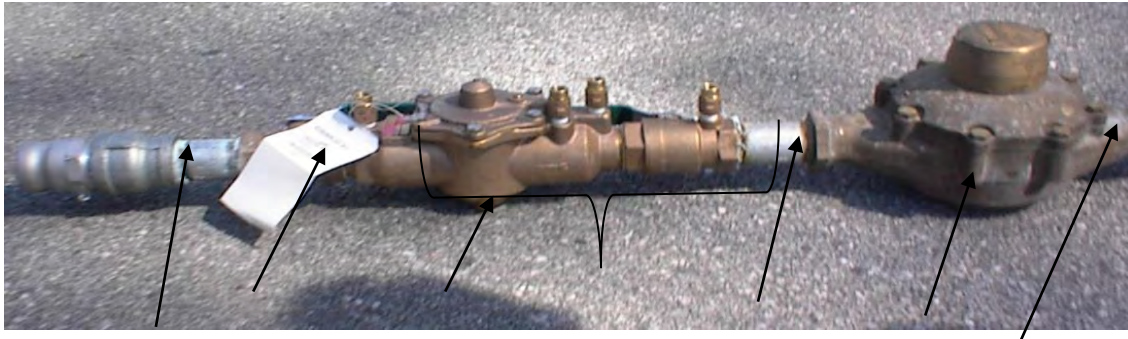
- D. Tree Protection: All trees located in the road right-of-way and along the sewer easements shall be protected from damage. Any trees damaged shall be replaced to the satisfaction of the Engineer and CFPUA at no additional cost to the Owner.

#### 1.7 RESPONSIBILITY FOR DAMAGE

- A. The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.
- B. When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or inconsequence of the non-execution thereof by the contractor, he shall restore, at his own expense, such property to a condition equal to or better than existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner.

#### 1.8 CFPUA WATER SUPPLY AND BACKFLOW PREVENTION REQUIREMENTS

- A. The Contractor shall meet all CFPUA requirements for connecting to hydrants. The Contractor shall obtain a permit for connecting to the CFPUA's hydrants. The permit application is titled "Procedure for Obtaining Special Water Use" and can be obtained from CFPUA, Community Compliance at 628 Groundwater Way, Wilmington, NC 28411.
- B. The requirements for connecting to hydrants are specified by the CFPUA, Community Compliance. No mobile hydrant meter shall be connected to an CFPUA hydrant without approval from Community Compliance. The Contractor is responsible for the purchase and assembly of an approved mobile hydrant meter with backflow preventer assembly. All approved standard assemblies can be obtained from Community Compliance. A permit and complete assembly are required for each vehicle that will obtain water – meters cannot be moved from one vehicle to another unless otherwise approved by the CFPUA, Community Compliance. The hydrants shall be operated in a manner as defined by CFPUA. The Contractor shall be responsible for any damage caused by improper operation of hydrants. The Contractor is responsible for meeting all requirements whether listed herein or not.
- C. The Contractor shall submit to the Engineer or CFPUA, a copy of the approved permit for each vehicle prior to obtaining water.
- D. Backflow Prevention
  - 1. Typical Design Template for Mobile Hydrant Meter with Reduced Pressure Backflow Prevention Shown Below:



Coupling w/  
hose connector

RP backflow  
preventer

Coupling

Meter

Connection for  
hose to hydrant

- a. Diameters may vary, a 2" meter assembly is shown. When assembly is set up for a smaller size meter (e.g. 3/4"), then the couplings would be 3/4" or 5/8".
- b. Fire hose fitting shall be a 2-1/2" Wilmington Thread. Adapters are available for Wilmington Thread to National Standard Thread.
- c. Meters shall register in gallons. Kent, Sensus, Hersey, or Neptune meters are approved for this application.
- d. Local material suppliers for this assembly:
  - 1) Core and Main – 6501 Amsterdam Way
  - 2) National Water Works – 407 Landmark Drive
  - 3) Wilmington Rubber & Gasket – 609 Greenfield Street
  - 4) Fortiline Waterworks – 3321 US-421 N.
- e. A partial list of approved reduced pressure backflow preventers follows. Others may also be approved.

Febco 835B	Conbraco 40-202-A2	Watts 009M2QT	Wilkins 975	Ames 4000B
Febco 825	Conbraco 40-203-02	Watts 909	Wilkins 975XL	Ames 4000SS
Febco 825Y	Conbraco 40-205-A4	Watts 009QT	Wilkins 975XLV	
Febco 860	Conbraco 40-200-02	Watts 009M1QT	Wilkins 575	
	Conbraco 40-204-99T	Watts 009SSQT		
	Conbraco 40-203-A2			

## 1.9 NCDEQ MINIMUM SEPARATION OF WATER AND SEWER UTILITIES

- A. In accordance with 15A NCAC 02T .0305 (f), the following minimum separations shall be provided for the sewer system except as allowed by Paragraph (g) of this Rule:
1. Storm sewers and other utilities not listed below  
(vertical) 24 inches
  2. Water mains  
(vertical-water over sewer including in benched trenches) 18 inches  
(horizontal) 10 feet
  3. Reclaimed water lines  
(vertical – reclaimed over sewer) 18 inches  
(horizontal) 2 feet
  4. Any private or public water supply source, including any wells, WS-I waters or Class I or Class II impounded reservoirs used as a source of drinking water 100 feet
  5. Waters classified WS (except WS-I or WS-V), B, SA, ORW, HQW, or SB from normal high water (or tide elevation) and wetlands 50 feet
  6. Any other stream, lake, impoundment, or ground water lowering and surface drainage ditches 10 feet
  7. Any building foundation 5 feet
  8. Any basement 10 feet
  9. Top slope of embankment or cuts of 2 feet or more vertical height 10 feet
  10. Drainage systems and interceptor drains 5 feet
  11. Any swimming pool 10 feet
  12. Final earth grade (vertical) 36 inches
- B. In accordance with 15A NCAC 02T .0305 (g), the following alternatives where separations in Paragraph (f) of this Rule cannot be achieved. Nothing in this Paragraph shall supersede the allowable alternatives provided in the Commission for Public Health Public Water Supply Rules (15A NCAC 18C), Commission for Public Health Sanitation Rules (15A NCAC 18A) or the Groundwater Protection Rules (15A NCAC 02L and 15A NCAC 02C) that pertain to the separation of sewer systems to water mains or public or private wells:
1. For storm sewers, engineering solutions such as ductile iron pipe or structural bridging to prevent crushing the underlying pipe.
  2. For public or private wells, piping materials, testing methods and acceptability standards meeting water main standards shall be used where these minimum separations cannot be maintained. All appurtenances shall be outside the 100-foot radius. The minimum separation shall however not be less than 25-feet from a private well or 50-feet from a public well.
  3. For public water mains horizontal or vertical separations, alternatives as described in 15A NCAC 18C .0906(b) and (c) as follows:
    - a. (b) Crossing a Water Main Over a Sewer. Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18-inch vertical separation, in which case, both the water main and sewer shall be

constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10-feet on each side of the point of crossing.

- b. (c) Crossing a Water Main Under a Sewer. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10-feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.
4. For less than 36-inches cover from final earth grade, ductile iron pipe shall be specified. Ductile iron pipe or other pipe with proper bedding to develop design supporting strength shall be provided where sewers are subject to traffic bearing loads.
5. For all other separations, materials, testing methods and acceptability standards meeting water main standards (15A NCAC 18C).

#### 1.10 RESTORATION OF DISTURBED AREAS

- A. The Contractor will be required to complete all restoration to disturbed areas within a timely manner following work completion.
- B. All restoration work shall conform to the CFPUA, City of Wilmington, and NCDOT permits for replacement and/or restoration and shall equal or exceed pre-construction conditions.
- C. Restorations include, but is not limited to, grading, seeding, mulching, pavement, sidewalks, driveways, storm drain pipes, curbs and gutters, fences, sign replacement and mailbox replacement.
- D. Existing fences that are disturbed during construction shall be repaired or replaced to a condition equal to or better than the original unless a release is obtained in writing from the property owner and submitted to the Engineer or CFPUA. All fences shall be replaced immediately after operations have cleared the fence line.
- E. Restoration of affected areas shall begin immediately upon termination of operations in the area disturbed.
- F. If the Contractor fails to adhere to this provision, all Work operations will be stopped until compliance is met.
- G. Restoration will be performed by the Contractor to the satisfaction of the Engineer and State, City or local utility permitting authorities.
- H. All costs for restoration shall be incidental to the contract.

#### 1.11 REGULATORY ENFORCEMENT ACTIONS IMPOSED

- A. The Contractor shall be fully responsible for any and all violations of regulatory permit conditions issued for the Work. In the event that a violation occurs or if a Notice of Violation (NOV) is received, the Contractor shall take immediate action to correct the violation as directed or required by State and Federal Agencies, Engineer or CFPUA.

Any penalties and fines resulting from such violation shall be assessed to the Contractor. In the event that a violation resulting from the Contractor's activities results in a Cease Work Order by the U.S. Corps of Engineers or other responsible state or federal agency, the Contractor shall be held fully responsible for all damages resulting from such delay and any associated penalties.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

## SECTION 01 40 00

### QUALITY REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality control.
- B. References.
- C. Labeling.
- D. Testing and inspection services.
- E. Manufacturers' field services.

##### 1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

##### 1.3 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date for receiving Bids except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

#### 1.4 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
  - 1. Model number.
  - 2. Serial number.
  - 3. Performance characteristics.

#### 1.5 TESTING AND INSPECTION SERVICES

- A. Testing Services Provided by Contractor: Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:
  - 1. Any inspections, tests or approvals required for Engineer acceptance of materials or equipment to be incorporated in the Work. This includes any items required for acceptance of materials, concrete mix designs or equipment submitted for approval prior to Contractor's purchase for incorporation in the Work.
  - 2. Tightness testing of containment structures and pressure, leakage, or disinfection testing of piping as specified.
  - 3. Any Work (or part thereof) required by the Contract Documents to be approved by Owner, Engineer or other designated individual or entity. Contractor shall assume full responsibility for arranging and obtaining such approvals, pay all costs in connection therewith and submit to Engineer the required certificates of approval. Excluding those conducted directly by an Authority Having Jurisdiction or expressly specified to be conducted directly by Contractor, inspections and tests shall be performed by independent inspectors, approved agencies or other qualified individuals or entities acceptable to Owner and Engineer.
- B. Testing Services and Special Inspections Provided by Owner: Testing services provided by Owner are for the sole benefit of Owner and/or as required by the governing building code. Owner shall employ and pay for the services of an independent testing laboratory, approved agency or other qualified individual or entities for inspections, tests or approvals required by the Contract Documents for field quality control. These include items indicated as Owner provided in the following sections:
  - 1. 03 05 00 Concrete (For Smaller Projects)
  - 2. 32 13 01 Concrete Sidewalks, Driveways, and Gutters
  - 3. 31 23 34.01 Excavating, Trenching, Dewatering and Backfilling
  - 4. 33 14 20 Disinfection of Water Pipelines, Facilities and Appurtenances
  - 5. 43 21 39.13 Submersible End Suction Pumps
  - 6. Other materials and equipment at the discretion of Owner.



Contractor shall provide access to the site and Work. Contractor shall give timely notice of the readiness of the Work for inspection, tests or approvals and shall cooperate with the inspection and testing personnel to facilitate the required tests and inspections. Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. When testing activities, including sampling, are performed in the field by Engineer or Agency personnel, Contractor shall furnish personnel and facilities to assist in the activities as required.

- C. Transmittal of Test Reports: Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Submittals – 01 33 00.

#### 1.6 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment as applicable, and to initiate instructions when necessary.

#### PART 2 PRODUCTS – NOT USED

#### PART 3 EXECUTION – NOT USED

END OF SECTION



SECTION 01 60 00  
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards in CFPUA Materials Specification Manual (MSM).
- B. MSM specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.

- E. Provide bonded off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.

#### 1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by MSM Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming Three or More Manufacturers: Products of manufacturers named and complying with Specifications; no options or substitutions allowed without CFPUA approval.
- C. Substitutions to be reviewed and permitted before bid receipt or final plan approval.

#### PART 2 PRODUCTS – NOT USED

#### PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 70 00  
EXECUTION AND CLOSEOUT REQUIREMENTS  
(DEVELOPMENT PROJECTS)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field surveying.
- B. Closeout procedures.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Project record documents.
- F. Operation and maintenance data.
- G. Spare parts and maintenance products.
- H. Product warranties and product bonds.
- I. Examination.
- J. Execution.
- K. Cutting and patching.
- L. Protecting installed construction.
- M. Final cleaning.
- N. Certification, Conveyance, and Plats.

1.2 FIELD SURVEYING

- A. Employ licensed land surveyor for Project layout and location records.
- B. Locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is established by Engineer-provided survey and indicated on Drawings.
- D. Verify easements; confirm Drawing dimensions and elevations.

- E. Provide field surveying and recording services. Establish elevations, lines, and points using recognized survey practices.
- F. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.
- H. Final Record Survey: Prior to Substantial Completion, submit markup of final record in accordance with Project Record Documents in this section.

### 1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Utility Activation: Complete following items before requesting Utility Activation, either for entire Work or for portions of Work:
  - 1. Complete testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to CFPUA's operating and maintenance personnel as specified in compliance with this Section and CFPUA Specification Section 01 30 00, Administrative Requirements.
  - 2. Submit maintenance manuals, spare parts, Project record documents, markups, gravity sewer video inspection, warranty letters and other similar final record data in compliance with this Section.
  - 3. Coordinate Final Walk Through inspection by CFPUA to establish basis for request that Work is complete.
  - 4. Make final change-over of locks and transmit keys directly to CFPUA. Advise CFPUA's personnel of change-over in security provisions.
  - 5. Discontinue or change over and remove temporary facilities and services from Project Site.
  - 6. Perform final cleaning according to this Section.

### 1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Engineer seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.

- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

#### 1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to CFPUA personnel.
- B. Demonstrate Project equipment and instructed by authorized manufacturer's representative who is knowledgeable about the Project.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with CFPUA personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

#### 1.6 PROJECT RECORD DOCUMENTS

- A. Maintain one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Reviewed Shop Drawings, product data, and Samples.
  - 4. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Record information concurrent with construction progress, not less than weekly. Report recording status at progress meetings.
- D. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates used.
  - 3. Changes made by Addenda and modifications.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
  - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
  - 2. Include locations of concealed elements of the Work.
  - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.

4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
  5. Identify and locate existing buried or concealed items encountered during Project.
  6. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  7. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  8. Field changes of dimension and detail.
  9. Details not on original Drawings.
- F. Certified, surveyed record drawings (“as-built” plans), sealed by a North Carolina licensed Professional Land Surveyor and/or Professional Engineer, shall be furnished to the Cape Fear Public Utility Authority (Authority) by the Engineer of Record (or Developer where applicable) upon completion and acceptance of the infrastructure by the Authority. The “as-built” plans shall conform to the as-built checklist included herein.
- G. For sewer projects, the “as-built” plans shall include accurate information regarding pipe size, pipe material, pipe length, manhole construction (size of manhole, invert, rim, alignment, location), services, and pump stations along with any relevant rights-of-way, property boundaries and easements. Plans shall also include sewer profiles showing any utility crossings along with the aforementioned information.
- H. For pump station projects, the “as-built” plans shall include accurate information regarding interior and exterior pipe sizes, material, length, as well as all structural dimensions of the pump station, all electrical equipment (make and model), pump information (make, model, and impeller size), and site layout information. Top plan, sectional plan, and full cross-section views are required on the “as-built” plans.
- I. For water projects, the “as-built” plans shall include accurate information regarding pipe size, pipe material, pipe length, valve locations (and turn direction), hydrant locations, fitting locations, services, and blow-off locations along with any relevant rights-of-way, property boundaries and easements.
- J. Submit marked-up paper copy documents to Engineer at each payment request and before Substantial Completion.
- K. Digital “as-built” information shall be provided by the Engineer of Record in AutoCAD format and PDF format with seal, signature, and date by surveyor and engineer and shall include all information required on the “as-built” drawings. No other digital formats will be accepted.



**AS-BUILT CHECK LIST Rev. 5**  
**CAPE FEAR PUBLIC UTILITY AUTHORITY**

Date: \_\_\_\_\_  
 Subdivision name: \_\_\_\_\_  
 Reviewed by: \_\_\_\_\_  
 CFPUA Project Number: \_\_\_\_\_

W	S	#	✓ - COMPLETED	X - INCOMPLETE	N/A - NOT APPLICABLE
		1	Name of subdivision (if applicable), owners name, date of construction, north arrow, scale, vicinity map and as-built plan		
		2	Drawings shall indicate water/sewer phases and their relationship to subdivision phases		
		3	Sheet numbers and number of total sheets.		
		4	Clearly indexed cover sheet with location of plan - profile sheets on cover sheet, by sheet number		
		5	Accurate location map and index planning map at a scale of 1 inch = 200 feet.		
		6	Total linear feet on cover sheet listed by phases: Water lines: _____ Gravity lines: _____ Force main: _____		
		7	Certifications notes listed by phase and location on cover sheet		
		8	All inverts into and out of manholes shall be field verified to 1/100 ft.		
		9	Show manhole top elevation & flood elevation or surface water flow levels @ each MH.		
		10	Elevations shall be tied to mean sea level. Indicate any benchmarks within project area.		
		11	Manhole sewer monuments, if manhole is buried.		
		12	Show approximate vertical and horizontal separations of waterlines, sewer mains, and force mains to proposed or existing utilities and structures (includes storm water piping)		
		13	For each sewer reach, show pipe diameter, length, type, slope, existing surface elevations and proposed finish grades. Show station or distance to beginning and end of change in pipe material.		
		14	Show location of air release valves, gate valves and fittings along water main and sanitary sewer force main.		
		15	Show stations and material types for force main.		
		16	Plans shall show stubs for individual services. C/O shown open circle, water meters open box. Sewer Cleanouts (COs) shall be located by measuring from each manhole along the sewer main up stream to a point which lies on a line that is perpendicular to the sewer main and connects said point and C.O. - zero point shall be the immediate downstream manhole and measured from main to C/O, i.e., 127/14R. No stations shall be used. Indicate size and location of all of services.		
		17	Indicate size of services greater than 4".		
		18	Indicate manhole service taps, service casing &/or material transition.		
		19	All lettering shall be at least 0.10 inches in height. The scale shall be 1" = 50' (horizontal) and 1" = 5' (vertical).		
		20	As-built plans shall be inked on original base mylar sheets (24" X 36"), or the engineer shall provide drawings on Dupont Crovx Erasable Image (wash-off) sheets or approved equal. A PDF and digital copy (format no older than AutoCAD 2005) must be provided to the Authority. All drawings shall become the property of the Cape Fear Public Utility Authority.		
		21	Reference ties into existing sewer systems by title and page of as-built drawing for existing system. The Authority will assist with obtaining this information, (i.e. existing manhole number, project name, CFPUA number and sheet number. Show information on plan-profile sheet and cover sheet.		
		22	Lot numbers, property lines and owner reference lines, street names and all easements		
		23	Engineer's seal and Surveyor's seal as applicable or required		
		24	Show all water supply wells within 50' & community wells within 100' of sewer main.		
		25	Water & sewer layers to be bolder line type than drainage, streets, etc.		
		26	Make contour lines very light or turn off		

Date Final Inspection Completed \_\_\_\_\_

Inspectors Signature \_\_\_\_\_

Approved:

Revision:

## 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Submit data bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable plastic covers.
- C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Contact information for warranty items.
    - g. Safety precautions to be taken when operating and maintaining or working near equipment.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop Drawings and product data.
    - b. Certificates.
    - c. Photocopies of warranties and bonds.

## 1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.
- B. Deliver to Project Site and place in location as directed by CFPUA; obtain receipt prior to final payment.

## 1.9 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of Work.
- B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include table of contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final completion.
- G. Time of Submittals:
  - 1. For equipment or component parts of equipment put into service during construction with CFPUA's permission, submit documents within ten days after acceptance.
  - 2. Make other submittals prior to final completion.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that existing Site conditions are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Examine and verify specific conditions described in individual Specification Sections.
- C. Verify that utility services are available with correct characteristics and in correct locations.

### 3.2 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step, in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
  - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
  - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
- E. Allow for expansion of materials.
- F. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
  - 1. Refer questionable mounting heights choices to Engineer for final decision.
- G. Adjust operating products and equipment to ensure smooth and unhindered operation.
- H. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

### 3.3 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
  - 1. Structural integrity of element.
  - 2. Integrity of weather-exposed or moisture-resistant elements.
  - 3. Efficiency, maintenance, or safety of element.
  - 4. Work of CFPUA or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
  - 1. Fit the several parts together, to integrate with other Work.
  - 2. Uncover Work to install or correct ill-timed Work.
  - 3. Remove and replace defective and nonconforming Work.
  - 4. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest joint or intersection; for equipment assembly, refinish entire unit.
- J. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

### 3.4 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Protect corrosion protected (coated) surfaces. When activity is necessary, obtain recommendations for protection from coating material manufacturer.
- D. Prohibit traffic from landscaped areas.

### 3.5 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
- B. Clean Site and Facilities; sweep paved areas, rake clean landscaped surfaces.
- C. Remove waste and surplus materials, rubbish, and construction facilities from Site.

### 3.6 Certification, Conveyance, and Plats

- A. Follow the Certification, Conveyance, and requirements outlined in the Development Process and Procedures Manual.

END OF SECTION



## SECTION 02 41 00

### DEMOLITION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide all labor, materials, equipment, and incidentals as shown, specified and required for all demolition, removal, and disposal of Work.
- B. Scope:
  - 1. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of foundations, piping, manholes, paving, curbs, sidewalks, gutters, fencing and similar existing facilities to a minimum of 5 ft below grade.
  - 2. Demolition and removal of all Underground Facilities underneath, and above-grade piping and utilities, in the building(s) and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are shown or are indicated to remain.
  - 3. Remove from slabs and foundations that are to be demolished all utilities embedded in such construction.
  - 4. Demolitions and removals specified under other Sections shall comply with requirements of this Section.
  - 5. Perform demolition Work within areas shown or indicated.
  - 6. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition.

##### 1.2 RELATED REQUIREMENTS

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Section 32 92 01 – Seeding and Sodding.
- C. Section 31 23 34 – Excavation, Trenching, Dewatering and Backfilling.

##### 1.3 ITEMS TO REMAIN IN PLACE

- A. Take necessary precautions to avoid damage to existing items that remain in-place.
- B. Trees are to be protected.

##### 1.4 COORDINATION

- A. Prior to start of Work, Contractor shall confirm with Owner and Engineer that all utilities and services are inactive. Contractor is responsible for disconnecting all services as indicated.

##### 1.5 SUBMITTALS

- A. Informational Submittals: Submit the following:
  - 1. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
    - a. Plan for coordinating shut offs, capping, temporary services, and continuing utility services.
    - b. Equipment proposed for use in demolition operations.
    - c. Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
    - d. Planned demolition operating sequences.
    - e. Detailed schedule of demolition Work in accordance with the accepted Process Schedule.

## 1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
  - 2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.
- B. Regulatory Requirements:
  - 1. Demolition, removal, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T - Demolition), and all other Laws and Regulations.
  - 2. Comply with requirements of authorities having jurisdiction.

## PART 2 PRODUCTS

- A. Backfill Materials: Refer to Section 31 23 34 - Excavation, Dewatering, Trenching, and Backfilling and Section 32 92 01 Seeding and Sodding.

## PART 3 EXECUTION

### 3.1 NOTIFICATION

- A. At least 48 hours prior to commencing demolition or removal, notify Engineer and Owner in writing of planned start of demolition Work. Do not start removals without permission of Engineer and Owner of infrastructure to be demolished.
- B. Protection of Surrounding Areas and Facilities:
  - 1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties.
  - 2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.



3. No area, section, or component of floors, roofs, walls, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure.
  4. Provide temporary barriers, lighting, sidewalk sheds, and other necessary protection.
  5. Repair damage to facilities that are to remain.
- C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, do the following:
1. Should uncharted or incorrectly charted Underground Facilities be encountered, Contractor responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
  2. Sanitary Sewer: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
  3. Water Piping: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished.
  4. Shutdown of all other utility services shall be coordinated by Contractor.

### 3.2 DEMOLITION – GENERAL

- A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.
- B. Pollution Controls:
1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 50 00 – Temporary Facilities and Controls.
  2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
  3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions.
- C. Explosives:
1. Do not bring explosives to the Site or use explosives.
- D. Building or Structure Demolition:
1. Unless otherwise approved by Engineer, proceed with demolition from top of building or structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
  2. Demolish concrete and masonry in small sections.
  3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
  4. Break up and remove foundations and slabs-on-grade unless otherwise shown or indicated as remaining in place.
- E. Demolition of Site Improvements:

1. Pavement, Sidewalks, Curbs, and Gutters: Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
  2. Fencing, Guardrails, and Bollards: Remove to the limits shown or indicated on the Drawings. Completely remove below-grade posts and concrete.
  3. Manholes, Vaults, Chambers, and Handholes: Remove to the limits shown or indicated on the Drawings.
  4. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes: Remove to the extent shown or indicated on the Drawings. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the "Mechanical Removals" Article in this Section.
  5. Landscaping: Comply with Section 32 92 01 – Seeding and Sodding.
- F. Salvage and Ownership:
1. Refer to Section 01 70 00 – Execution and Closeout Requirements, for requirements on salvage, ownership, and handling of equipment and materials removed during demolition and removal Work.
  2. Materials and equipment to remain Owner's property shall be carefully removed and appropriately handled by Contractor to avoid damage and invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by Engineer or Owner.
- G. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re finished with materials that match existing adjacent surface, or as otherwise approved by Engineer.

### 3.3 WATER / SEWER UTILITY STRUCTURE ABANDONMENT

- A. Manholes, vaults, wet wells and other underground utility structures to be abandoned (TBA), as noted on the Drawings, shall be demolished to 5 feet below grade. All pipes entering or exiting the structure shall be capped as noted on Design Drawings. The structure shall be filled with granular material, topped with suitable backfill material compacted to 90% standard proctor, or better, and prepared for seeding. Access must be along established utility easements and only allowed during dry conditions. Any disturbed areas at the structure or en route to the structure will be seeded and mulched.
- B. Where a gravity sewer main is to be abandoned, the Contractor shall furnish and install the necessary materials to cap both the upstream and downstream manhole inverts, or, as directed by the Engineer to properly abandon the sewer main. The sewer main shall be capped on each end and abandoned in place.
- C. Where a sewer force main or water main is to be abandoned, the Contractor shall furnish and install the necessary materials to cap the terminal end of the main, or where shown on the drawing or directed by the Engineer to properly abandon the main.
- D. Mains abandoned within existing road or street rights-of-way shall comply with the permit requirement of the Owner (NC DOT or City of Wilmington).

- E. Mains to be abandoned shall be filled with flowable fill unless otherwise directed by Owner and Engineer.
- F. Pressurized mains shall be abandoned and capped with appropriate fittings and restraints as indicated on the drawings.

### 3.4 DISPOSAL OF DEMOLITION DEBRIS

- A. Remove from the Site all debris, waste, rubbish, and material resulting from demolition operations and equipment used in demolition Work. Comply with the General Conditions, Supplementary Conditions.
- B. Transportation and Disposal:
  - 1. Non-hazardous Material: Properly transport and dispose of non-hazardous demolition debris to a permitted landfill or other suitable location permitted by the Division of Solid Waste Management, in accordance with Laws and Regulations. Non-hazardous material does not contain Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, or other material designated as hazardous in Laws and Regulations.
  - 2. Hazardous Material: When handling and disposal of hazardous materials is included in the Work, properly transport and dispose of hazardous materials in accordance with the Contract Documents and Laws and Regulations.
- C. Submit to Engineer information required in this Section on proposed facility(ies) where demolition material will be recycled. Upon request, Engineer or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Engineer and Owner.

END OF SECTION



## SECTION 02 82 13

### ASBESTOS ABATEMENT FOR UTILITIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Scope:
  - 1. Provide all labor, materials, equipment and incidentals as shown, specified and required for all removal and disposal of material containing or coated with ACM.
- B. Section Includes:
  - 1. Cutting or removal of pipelines coatings containing or coated with ACM.
  - 2. Monitoring of Work area during cutting and cleaning operations.

##### 1.2 REFERENCES

- A. Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:
  - 1. ANSI/AIHA Z9.2, Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems.
  - 2. ANSI/ISEA Z87.1, Occupational and Educational Eye and Protection Devices.
  - 3. ANSI Z88.2, Respiratory Protection.
  - 4. ASTM D4397, Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
  - 5. ASTM E1368, Practice for Visual Inspection of Asbestos Abatement Projects.
  - 6. NFPA 10, Portable Fire Extinguishers.
  - 7. NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
  - 8. NFPA 101, Life Safety Code.
  - 9. NFPA 701, Methods of Fire Tests for Flame Propagation of Textiles and Films.
  - 10. NIOSH NMAM, NIOSH Manual of Analytical Methods.
  - 11. UL 586, High-Efficiency, Particulate, Air Filter Units.
  - 12. USEPA 340/1-90-018, Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance.

##### 1.3 DEFINITIONS

- A. ACM: Asbestos-containing material.

##### 1.4 SUBMITTALS

- A. Product Data: Manufacturer information on respirators and air monitor.
- B. Manufacturer's Certificate: Products meet or exceed specified requirements.
- C. Qualification and certification Statements:
  - 1. Qualifications and certifications for contractor, on-Site representative, and disposal firm.

## 1.5 QUALITY ASSURANCE

- A. Perform Work according to OSHA and North Carolina Department of Public Health standards.
- B. Contractor: Company certified in repairing, modifying, cleaning, or removing AC pipe or ACM-coated pipe as specified in this Section.
- C. On-Site Representative: Person trained and certified in performing Work of this Section.
- D. Disposal Firm: Company certified in packaging and hauling ACM to disposal site.
- E. Active Waste Disposal Site: Solid waste disposal site permitted to accept ACM waste.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials according to manufacturer instructions.
- B. Respirators Not in Use:
  - 1. Store in sanitary location that protects respirators from dust, sunlight, heat, extreme cold, excessive moisture, and potentially damaging chemicals.
  - 2. Place in plastic bags or closed containers.

## PART 2 PRODUCTS

### 2.1 RESPIRATORS

- A. Manufacturers:
  - 1. Furnish materials according to 29 CFR Part 1926, CFR 11 Part 30, and 29 CFR Part 1910.
- B. Description:
  - 1. Comply with manufacturer's recommendations, 29 CFR Part 1926.1101, and shall be approved by the Mine Safety and Health Administration and NIOSH (MSHA/NIOSH) for use in environments containing airborne Asbestos fibers.
  - 2. Type: Half-face mask; reusable after washing.
  - 3. Maintenance: Replaceable filters and cartridges only.
  - 4. Single-use respirators are not acceptable.
    - a. Filters: Type H, high-efficiency particulate air (HEPA). As a minimum a powered-air purifying respirator (PAPR) equipped with HEPA cartridges shall be worn during startup of Asbestos removal activities, unless otherwise approved in writing by the CIH.
- C. Performance and Design Criteria:
  - 1. Application: Asbestos abatement for concentrations up to 10 times permissible exposure limit (PEL).
  - 2. Design: Low profile.

## 2.2 AIR MONITOR

### A. Manufacturers:

1. Furnish materials according to N.C. General Statute §130A-444 through 452 - Asbestos Hazard Management, 10A NCAC 41C .0601 - Asbestos Hazard Management Program, and 40 CFR 61-141-157 Subpart M, standards.

## PART 3 EXECUTION

### 3.1 PREPARATION

- ### A.
1. Perform ACM removal without damage to or contamination of adjacent Work or existing area.

### 3.2 APPLICATION

### A. Cutting and Disposal:

1. Transport removed piping to a central staging area to cut for transport or disposal.
2. Deposit pipeline pieces in leakproof metal collection box secured with tarpaulin covers.
3. Transport filled boxes to an approved landfill.
4. A licensed and certified asbestos supervisor will accompany transport vehicles to manage transport process.
5. Maintain supply of fresh water near cutting operation to keep freshly cut areas of ACM damp while cutting piping.
6. Individually wrap each joint of piping and pipe ends prior to loading.

### 3.3 FIELD QUALITY CONTROL

### A. Sample Testing:

1. When required in Bid Form, test pipe or pipe coating for asbestos prior to repairing, modifying, or removing pipelines by removing samples of pipe or coating along entire length of piping to be removed and have testing laboratory determine quantity of asbestos that may be present.
2. Testing and evaluation, including obtaining of samples, shall be by Owner's designated independent testing firm.

END OF SECTION





## SECTION 31 23 34.01

### EXCAVATING, TRENCHING, DEWATERING AND BACKFILLING FOR UTILITY WORK

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Furnish all labor, equipment, supplies and materials, and perform all operations in connection with the following:
  - 1. Clearing, grubbing, and preparation of the site; removal and disposal of all debris;
  - 2. Pipeline and utility structure excavations including trenching, subgrade preparation, embedment, backfilling, pumping and dewatering
  - 3. Tunnels (trenchless construction) crossings;
  - 4. Sheet piling, shoring, and protection of work;
  - 5. Borrow, transportation, handling, storage, and disposal of suitable and unsuitable materials for pipelines, utility structures, site fills, curbs and gutters, sidewalks, driveways, and pavements
  - 6. Subgrade preparation, grading, wetting, rolling, surfacing and other operations pertaining to the site work
  - 7. Protection of adjacent property;
- B. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.
- C. Related Requirements:
  - 1. Section 03 05 00 - Concrete
  - 2. Section 32 92 01 - Seeding and Sodding
  - 3. Section 33 14 13 - Water Distribution Piping, Valves, Hydrants, and Appurtenances
  - 4. Section 31 31 11 - Sanitary Sewer Gravity Mains
  - 5. Section 33 31 23 - Sanitary Sewer Force Mains, Valves, and Appurtenances
  - 6. Section 33 32 11 - Wastewater Pumping Stations

##### 1.2 REFERENCES

- A. Definitions:
  - 1. "Subgrade" is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.
- B. Reference Standards:
  - 1. OSHA - Safety and Health Regulations for Construction, Chapter XVII of Title 29, CFR, Part 126
  - 2. NCDOT Positive Shoring Plan - issued with Right-of-Way Encroachment Agreement
  - 3. AASHTO T99/T180 - Standard Method of Test for Moisture-Density Relations of Soils.
  - 4. ASTM C136 - Sieve analysis of fine and coarse aggregates.
  - 5. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

6. ASTM D698 - Tests for moisture-density relations of soils and soil-aggregate mixture using 5.5 lb (2.49 kg) rammer and 12 inch (305 mm) drop.
7. ASTM D2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
8. ASTM D2487 - Classification of Soils for Engineering Purposes.
9. ASTM D4253 - Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
10. ASTM D4254 - Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
11. ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
12. ASTM D4832 - Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
13. ASTM D6023 - Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM).
14. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

### 1.3 SUBMITTALS

- A. Contractor Excavation Protection Plans or NCDOT Positive Shoring Plans:
  1. Provide sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property.
  2. At least 30 days before starting construction on sheeting and shoring, and in accordance with the OSHA and NCDOT requirements, the Contractor shall ensure the sheeting and shoring design engineer complete and submit the Protective System Design Certificate(s) for the sheeting and shoring systems that the Contractor will install.
  3. If required by the OSHA regulations to protect existing facilities, the Contractor shall submit separate certificates for each unique design. The certificate(s) shall be signed and sealed by the registered professional engineer that designed the protection system.
- B. Geotextile Fabrics: Samples, manufacturer's product data, installation instructions
- C. Embedment and Backfills Materials:
  1. Name and location of proposed material suppliers.
  2. Standard test results for materials proposed by independent materials testing firm.
- D. Trench Shields: Fabricator/manufacturer certifications

### 1.4 QUALITY ASSURANCE

- A. Contractor to provide experienced on-site Safety Officer and Superintendent to comply with OSHA regulations for site excavations and engineered shoring plans.
- B. Safety Officer and Superintendent shall hold OSHA 30-Hour Construction Certifications and classified as the competent person.

## 1.5 EXISTING SITE CONDITIONS

- A. Every reasonable effort has been made to provide accurate information on existing site conditions. The Contractor should become familiar with the site and satisfy himself as to the scope of the work involved and the materials to be encountered. Any significant change in conditions should be immediately brought to the attention of the Engineer.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Geotextile Fabric. The fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

1. Geotextile Fabric Type A. Geotextile fabric Type A shall be provided for installation at locations indicated on the Drawings and as specified herein. Geotextile Fabric Type A shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

<u>Property</u>	<u>Test Method</u>	<u>Unit</u>	<u>Minimum Average Roll Value *</u>
Fabric Weight	ASTM D3776	oz/yd <sup>2</sup>	5.7
Grab Strength	ASTM D4632	lb	155
Grab Elongation	ASTM D4632	percent	50
Mullen Burst Strength	ASTM D3786	psi	190
Apparent Opening Size	CW-02215	U.S. Std. Sieve Size	70

\* Minimum average roll value in weakest principal direction.

- B. Polyethylene Film: Polyethylene film beneath concrete slabs or slab base course material shall be Product Standard PS17, 6 mil minimum thickness.
- C. Granular Materials and Soils: Five classes defined according to properties and characteristics as follows.
- Class I** - Angular, 25 mm (1-in.) to No.4 (3/16 in.) in size, #57 or #67 graded stone or equivalent regional material from crushed rock, slag, and/or coral.
  - Class II** - Coarse sands and gravels with maximum size of 25 mm (1-in.), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.
  - Class III** - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.

- d. **Class IV** - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH, and CL are included in this class. These materials are not acceptable for bedding, haunching, or initial backfill.
  - e. **Class V** - This class includes the organic soil, OL, OH, PT as well as soils containing frozen earth, debris, rocks, larger than 37.5 mm (1-1/2 in.) in diameter, and other foreign materials. These materials are not acceptable for bedding, haunching, initial backfill, or final backfill.
- D. General Fill:
- 1. Use soils free of organic matter, refuse, rocks and lumps greater than 4 inches in diameter and other deleterious matter.
  - 2. Fill shall have a liquid limit not greater than 45, and plasticity index not greater than 25.
  - 3. Previously excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
  - 4. When on-site materials are found unsuitable for use as general fill, provide approved off-site general fill materials. Prior to using off-site material as general fill, furnish submittal for and obtain Engineer's approval of the material proposed for use.
  - 5. General fill material not otherwise specified shall be Class II or III.
- E. Granular Fill: Granular fill under floor slabs shall be Class I material.
- F. Structural Fill: Fill material placed inside the line of the building foundation or slab shall be Class I or II.
- G. Fill Under Pavement: Fill material used beneath pavement and for road shoulders shall be Class II or III.
- H. Topsoil: Natural, friable soil free of subsoil, stumps, rocks larger than 2 inches in diameter, weeds and other material detrimental to plant growth.
- I. Concrete: Concrete placed for cradles, thrust blocks, or encasement shall be Class B concrete as specified in Section 03 05 00 Concrete.
- J. Subbase Material:
- 1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand. Crushed slag is unacceptable.
- K. Drainage Fill:
- 1. Material shall be washed, uniformly-graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing 1-1/2-inch sieve and not more than 10 percent passing a No. 4 sieve (#57 or #67 stone).
- L. Controlled Low Strength Material (CLSM):
- 1. CLSM shall be self-leveling and self-compacting cementitious material.
    - a. Cement: Type I or Type II Portland cement complying with ASTM C150/C150M.
    - b. Fly Ash Mineral Admixture: Comply with ASTM C618, Class F.

- c. Water: Clean, potable.
  - d. Admixtures: Provide admixtures in accordance with product manufacturer's published instructions. Admixtures shall be compatible with each other. Do not use calcium chloride or admixtures containing chloride ions. Use only admixtures that have been tested and approved in the mix designs.
  - e. Fine Aggregates: ASTM C33/C33M.
2. CLSM Mix:
- a. Cement Content: 50 pounds per cubic yard.
  - b. Fly Ash Mineral Admixture: 250 pounds per cubic yard.
  - c. Fine Aggregate Content: 2910 pounds per cubic yard.
  - d. Water Content: 500 pounds per cubic yard.
  - e. Admixtures shall comply with manufacturer's recommendations for use with CLSM.
  - f. Unconfined compressive strength shall be not more than 100 psi.
  - g. Adjustment of Mixes.
    - 1) Mix design adjustments may be requested by Contractor when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
    - 2) Submit for Engineer's approval laboratory test data for adjusted mix designs, including compressive strength test results.
    - 3) Implement adjusted mix designs only after Engineer's approval.
    - 4) Adjustments to mix designs shall not result in additional costs to Owner.

## 2.2 SOURCE QUALITY CONTROL

- A. Perform quality assurance testing, and submit results to Engineer, in accordance with the 'Submittals' Article in Part 1 of this Section.

## PART 3 EXECUTION

### 3.1 INSPECTION

- A. Familiarization: Prior to commencement of the Work, become thoroughly familiar with the site, the site conditions, and all portions of the work specified in this Section.
- B. Provide Engineer with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. Do not proceed with the Work until unsatisfactory conditions are corrected.
- C. Approvals: Backfilling and grading operations near foundations, walls, pipes and other portions of the work to be covered shall not commence until the Engineer has completed all required inspections, tests and approvals. Work covered prior to inspection shall be uncovered for inspection purposes and backfilled.

### 3.2 SUBSURFACE UTILITY LOCATION AND EXPLORATION

- A. Existing Utilities Location:

1. Prior to excavation, Contractor shall contact local underground alert hotlines, "North Carolina 811" and/or individual utility owners for marking underground utilities. A survey shall be made of the utility size, material, location, and elevation prior to trench excavation and information shall be recorded on the record Drawings maintained by the Contractor.
2. Once utilities are marked and recorded, Contractor shall excavate to expose the existing utilities in advance of the construction.
3. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for utility location pits.
4. Contractor shall be responsible for the definite location of each existing underground utility involved within the area of excavation for the Work and exercise care during such location work to avoid damaging and disrupting the affected underground facilities or structures. Contractor shall be responsible for repairing, at his expense, damage to underground facility or structures caused during exploratory Work.

### 3.3 PREPARATION

#### A. Surface Preparation

1. Clearing: Areas designated for clearing and required for construction operations shall be cleared of trees, brush, structures and other materials within the defined rights-of-way, easements, and limits of disturbance indicated. Trees which are to remain shall be protected during clearing operations and subsequent work.
2. Grubbing: Roots, stumps and other materials shall be grubbed from the cleared areas to a depth of at least 18 inches. Tree stumps shall be grubbed in their entirety, including tap roots where applicable.
3. Topsoil: Strip existing topsoil to a depth of 4 inches from areas to be excavated or graded. Stockpile the topsoil in a suitable area for use during final grading operations. Protect the topsoil from excessive erosion.
4. Unsuitable Material: Remove sod, muck or other unsuitable material to firm subsoil in areas designated for filling or grading operations.
5. Disposal: Trees, stumps, roots, rubbish, unsuitable soil or other material resulting from surface preparation shall be removed from the site by the Contractor and disposed of.

#### B. Prohibited Work:

1. Burning or blasting and use of explosives is not allowed.

#### C. Dust Control:

1. Control objectionable dust caused by Contractor's operation of vehicles and equipment, clearing and other actions. To minimize airborne dust, apply water or use methods subject to approval of authorities having jurisdiction.

### 3.4 EXCESS WATER CONTROL

#### A. General Dewatering:

1. Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent ponding of water.
2. Remove all soil softened or eroded by the presence of water and replace with suitable backfill material.

3. Provide and maintain drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work areas. Keep excavations dry during execution of Work, subgrade preparation, and continually thereafter until the pipeline or structure to be built therein is acceptable to Engineer and backfilling operations are completed and acceptable to Engineer.
4. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
5. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
6. Contractor shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.

B. Temporary Dewatering Systems:

1. Contractor shall design, provide, and operate dewatering system to include sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, and similar facilities, necessary to depress and maintain groundwater level below the base of each excavation during all stages of construction operations.
2. Design and operate dewatering system to avoid settlement and damage to existing structures and underground facilities.
3. Groundwater table shall be lowered in advance of excavation for a sufficient period of time to allow dewatering of fine grain soils.
4. Maintain groundwater level at excavations 2-feet below lowest subgrade excavation until the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater.
5. Operate dewatering system continuously, 24-hours per day, 7-days per week. Provide standby pumping facilities and personnel to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without first obtaining Engineer's acceptance for such discontinuation.
6. Locate elements of temporary dewatering system to allow continuous dewatering operation without interfering with the Work to the extent practicable.
7. Where portions of dewatering system are located in the area of permanent construction, submit to and obtain Engineer's acceptance of details of proposed methods of constructing the Work at such location. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, and until waterproofing Work is completed.
8. Perform pumping of water from excavations in a manner that prevents carrying away of unconsolidated concrete materials, and that avoids damaging the subgrade.

C. Disposal of Water Removed by Dewatering System:

1. Contractor's dewatering system shall discharge to in accordance with the NC Sedimentation Pollution Control Act, NCDEQ Erosion Control Permit, and NC Stormwater Permit for Construction Activities.
2. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
3. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
4. Dispose of water in manner that causes no inconvenience to Owner, others involved in the Project, and adjacent and downstream properties.

### 3.5 SHEETING, SHORING AND BRACING

#### A. General:

1. Design and provide sheeting, shoring, bracing, cofferdams, and similar excavation supports as shown, specified, and required for the Work. Where sheeting, shoring, bracing or trench boxes are used, they must be designed and sealed by a professional engineer licensed to practice in the State of North Carolina.
2. Clearances and types of temporary sheeting, shoring, bracing, and similar excavation supports, insofar as they may affect the finished character of the Work and the design of sheeting to be left in place, will be subject to the Engineer's approval; but Contractor is responsible for adequacy of all sheeting, shoring, bracing, cofferdams, and similar excavation supports.
3. Materials:
  - a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.
  - b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
  - c. When required, provide permanent steel sheet piling or treated timber sheet piling where subsequent removal of sheet piling might allow lateral movement of soil under adjacent structures
4. As excavation progresses, carry down shoring, bracing, cofferdams, and similar excavation supports to required elevation at bottom of excavation.
5. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time-period excavations will be open.
6. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and underground facilities, their appearance, and adjacent construction.

#### B. Removal of Shoring, Sheeting and Bracing:

1. Remove sheeting and bracing from excavations, unless otherwise directed by Engineer in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and underground facilities.
2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
  - a. Concrete has cured for not less than 7 days.



- b. Wall and floor framing, up to and including grade level floors, is in place.
  3. When shoring is installed that does not extend below the invert of the underground structure, the shoring shall be removed. Backfill and compaction shall be executed in conformance with the specifications.
- C. Shoring Left in Place:
  1. Only shoring authorized by the Engineer and approved by the Engineer shall be left in place.
  2. When shoring is installed to extend below the underground structure, the shoring shall remain with the top edge 4-feet below the finished grade.
- D. Sheeting Left in Place:
  1. Materials: Steel sheeting shown or indicated to be left in place shall consist of rolled sections of continuous interlocking type. Steel sheeting material designated to be left in place shall be new. Type and design of the sheeting and bracing shall comply with the above requirements for steel work for all sheeting and bracing.
  2. Installation:
    - a. Steel sheeting to be left in place shall be driven straight to lines and grades as shown, indicated, or directed. Piles shall penetrate into firm materials with secure interlocking throughout pile's entire length. Damaged piling having faulty alignment shall be pulled and replaced by new piling.
    - b. Type of guide structure used and method of driving steel sheeting to be left in place shall be determined by Contractor's professional engineer.
  3. Cut off at elevations shown, indicated, or directed by Engineer sheeting left in place and remove cut off pilings from the Site.
  4. Clean wales, braces, and all other items to be embedded in the permanent structure, and ensure that concrete surrounding the embedded element is sound and free of air pockets and harmful inclusions. Provisions shall include the cutting of holes in the webs and flanges of wale and bracing members, and welding of steel diaphragm waterstops perpendicular to the centerline of brace ends that are to be embedded.

### 3.6 TRENCH EXCAVATION

- A. Cutting Existing Surface Pavements.
  1. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances.
  2. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1-½ inches deep along each side of the trench and along the perimeter of cuts for structures.
  3. Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 12-inches in width at any point is left between the cut edge of the pavement and the top edge of the trench.
  4. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.
  5. Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.

6. Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced.
  7. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.
- B. Trench Width: Trenches shall be excavated to a width which will provide adequate working space and sidewall clearance for proper installation, jointing, and embedment haunching. Trench banks from the top of the pipe to trench bottom shall be as vertical as practicable.
  - C. Over-Excavation: Over-depth excavation carried below required grade, unless authorized by the Engineer, shall be backfilled with Class I material and compacted as embedment at no additional cost to Owner.
  - D. Alignment and Depth: Trench to the lines and grades shown on the drawings. Where elevations are not shown, trench to a depth sufficient to provide at least 36-inches of cover above the top of pipe, unless otherwise specified. Grade trenches to provide a constant slope free of sags and high spots.
  - E. Dewatering: Keep trenches free of water.
  - F. Trench Bracing: Properly brace, sheet and support trench walls as soil conditions indicate and in conformance OSHA regulations. Provide adequate bracing and shoring to protect adjacent improvements according to contractor submitted excavation plan or NCDOT positive shoring plan. Contractor shall provide certification for all premanufactured trench bracing devices prior to any excavation activities.
  - G. Bedding, Haunching and Backfill: Tamp to provide firm, even bedding. Excavate bedding material to match the shape of the bottom of the pipe and bell, as detailed in the drawings. Shovel slice haunching material to provide full bearing around the bottom of the pipe.
  - H. Method of Compaction Density Testing: ASTM D698 Standard Proctor
  - I. Pipe Trench Construction: (Depth measured from top of pipe to final grade)
    1. Type A – Sewer mains 12-feet and deeper
      - a. Bedding, Haunching, and Initial Backfill – Class I bedding material, 4-inch minimum depth or 1/8 pipe diameter from stable subgrade to pipe invert; Class I haunching and initial backfill from invert to 6-inches above top of pipe; compact all zones to 95% standard density.
      - b. Final Backfill – Class II material from top of initial backfill to ground surface; compact to 95% standard density.
    2. Type B – Sewer mains between 6-feet and 12-feet deep (occasional water and sewer force mains)
      - a. Bedding and Haunching – Class I bedding material, 4-inch minimum depth or 1/8 pipe diameter from stable subgrade to pipe invert; Class I haunching to spring-line of pipe; compact both zones to 95% standard density.
      - b. Initial Backfill – Class II material from spring-line of pipe to 6-inches above top of pipe; compact to 95% standard density.

- c. Final Backfill – Class II or III material from top of initial backfill to ground surface; compact to 95% standard density.
  - 3. Type C – Sewer, water, and sewer force mains 3-feet to 6-feet deep
    - a. Bedding and Haunching – Class I material 4-inch minimum depth or 1/8 pipe diameter from stable subgrade to 1/6 pipe outside diameter above invert; compact to 95% standard density.
    - b. Initial Backfill – Class II or III material from top of pipe to a minimum of 6-inches above top of pipe; compact to 95 standard density.
    - c. Final Backfill – Class II or III material from top of initial backfill to ground surface; compact to 95% standard density.
  - 4. Type S – Water and sewer service lines 3-feet to 6-feet deep
    - a. Bedding, Haunching, and Initial Backfill – Class I or II material 3-inch minimum depth from stable subgrade to 3-inch minimum above top of pipe; compact to 95% standard density.
    - b. Final Backfill – Class II or III material from top of initial backfill to ground surface; compact to 95 percent standard density.
- J. Trench Compaction Lifts:
  - 1. Embedment and initial backfill zones – 6-inch lifts
  - 2. Final backfill zone – 8-inch lifts
- K. Subgrade Stabilization: Wet, yielding and mucky trench bottoms shall be stabilized by removal of the material and replacement with sufficient Class I embedment material to correct the instability.
- L. Backfilling Under NCDOT or City Pavements
  - 1. As indicated on standard detail drawings
    - a. Top 12-inches of final backfill for road or street subbase shall be compacted to 98% standard density or;
    - b. CLSM trench embedment and backfill.
- M. Trench Shields:
  - 1. When using a shield for installing pipe, bottom of the shield shall not extend below pipe spring-line and haunching embedment.
  - 2. When using a shield for installing structures, bottom of the shield shall not extend below the top of the bedding for the structures.
  - 3. When removing the shield or moving the shield ahead, exercise extreme care to prevent moving piping, structures, and other underground facilities, and prevent disturbance of bedding material for piping, structures, and other underground facilities. When piping, structures, or underground facilities are disturbed, remove and reinstall the disturbed items.

### 3.7 SITE AND STRUCTURE EXCAVATION

- A. Perform all excavation required to complete the Work as shown, specified, and required. Excavation shall include the removal and replacement of all asphalt, concrete, curb, rock, earth, fences, trees, shrubs, and other materials as applicable within the defined rights-of-way, easements, and limits of disturbance indicated.
- B. Excavation Protection:

1. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
  2. Provide and maintain excavation protection system(s) in accordance with submittals accepted by Engineer.
- C. All areas of the site shall be graded and maintained at all times to prevent surface runoff from draining into the excavations, and to prevent ponding of water therein.
- D. Excavation shall be accomplished in accordance with the grades and lines as established by the Engineer and as required by the work to be performed. Exercise care to prevent undercutting lower than the required subgrades. When excavations are made below required grades without written order of Engineer, fill such excavations with compacted select fill material, as directed by Engineer, at Contractor's expense.
- E. Extend excavations sufficiently on each side of foundation slabs, wet wells, manholes, valve vaults, and similar construction to allow setting of forms, installation of shoring and bracing, and the safe sloping of banks, as necessary.
- F. General Site Subgrades:
1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades that are otherwise solid but become soft or mucky on top due to construction operations shall be reinforced with select fill. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
  2. If, in Engineer's opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within Contractor's control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at Contractor's expense.
  3. Upon completion of site preparation and excavation, scarify to a depth of 12-inches and compact as specified. For areas to receive fill, the compacted subgrade shall be scarified to a depth of 4-inches prior to placing the fill.
- G. Proof-rolling Subgrades:
1. Prior to placing fill or constructing pavements or slabs-on-grade, proof-roll the subgrade surface with sufficient proof-rolling apparatus. Before starting proof-rolling, submit to and obtain acceptance from Engineer of proof-rolling apparatus and procedure to be used.
  2. Proof-rolling operations shall be made in the presence of Engineer. Notify Engineer in advance of start of proof-rolling operations.
  3. Subgrades displaying pronounced elasticity or deformation, deflection, cracking, or rutting shall be stabilized as directed by Engineer. Unsuitable materials shall be undercut to the depth directed by Engineer and replaced with select fill material. Other suitable stabilization methods may be directed by Engineer.
- H. Excavated Materials to be Used as Fill:
1. All materials from excavation, considered as suitable by the Engineer, shall be used as fill wherever required, and the Contractor shall arrange his work so that this usage of excavated materials will be possible.
  2. Stockpile excavated materials that are acceptable for use as fill.

3. As excavation proceeds, keep stockpiles of excavated materials suitable for use as fill separate from unsuitable materials and waste materials.
4. Place, grade, and shape stockpiles for proper drainage.
5. Locate and retain soil materials away from edge of excavations.
6. Dispose of excess soil material and waste materials.
7. Stockpiled excavated soils for use as select fill or general fill shall be tested and classified by laboratory as on-Site select fill or on-Site general fill. Perform required quality assurance testing for material verification on stockpiled materials as soon as possible to demonstrate compliance of excavated materials.

### 3.8 SITE AND STRUCTURE FILL AND COMPACTION

- A. Provide and compact all fill required for the finished grades as shown on the drawings.
- B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
  1. Engineer's authorization after observation of construction below finish grade, including damp-proofing, waterproofing, perimeter insulation, and similar Work.
  2. Inspection, testing, approval and recording of locations of underground facilities.
  3. Removal of concrete formwork.
  4. Removal of shoring and bracing, and filling of voids with satisfactory materials.
  5. Removal of trash and debris.
  6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
  7. Field testing of tanks, underground facilities including piping and conduits, and water-retaining structures.
- C. Fill that includes organic materials, debris, roots, trash, stones or other unacceptable material shall be removed and replaced with approved fill material.
- D. Borrow: The Contractor will supply all borrow necessary and will provide all labor and equipment necessary to dig and haul such borrow.
- E. Placement:
  1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and underground facilities.
  2. Fill shall be spread in successive layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly by motor grader or other approved device and rolled with an approved tamping or 3-wheeled power roller until thoroughly compacted to 90 percent of maximum density obtained at optimum moisture content, as determined by the AASHTO Standard Method T-180.
  3. Fill areas shall be undercut and proof-rolled as directed by Engineer.
  4. Place fill materials at moisture content and density as specified in Table 31 23 34-A of this Section and this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of diking, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning

before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.

5. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required. Use lightweight or hand operated compaction equipment within horizontal distance of 10 feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted areas next to structures and around piping and underground facilities. Effectiveness of the equipment selected by Contractor shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.
6. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.
7. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
8. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, Contractor shall perform all work required to provide the required densities. Such work shall include, at no additional cost to Owner, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
9. Repair, at Contractor's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by Engineer.
10. When any portion of the fill is constructed on an old road bed, the existing surfaces shall be scarified and manipulated as directed by the Engineer in order that, when compacted, it shall have a uniform density. Fills shall be shaped and maintained at all times during their construction to prevent an accumulation of standing water in the event of rain.

F. Fill Against Concrete:

1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 05 00 – Concrete.
2. Backfill structural foundation units as soon as practicable, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
3. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

- G. Fill in Electrical Ductbank Trenches:
1. Provide general fill for full depth of electrical ductbank trench, below and above electrical ductbank.
  2. Where one ductbank passes beneath another pipe or ductbank, provide select fill to the elevation of the bottom of upper ductbank or pipe, as applicable.
  3. Placing and compacting fill in electrical ductbank trenches shall comply with Type S trench construction requirements.
- H. Pavement:
1. Compact the subgrade and fill material beneath paved areas and shoulders to a minimum 98 percent ASTM D698 maximum density at optimum moisture content.
  2. Place 1-½ inches of temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas that will remain for permanent use.
  3. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
  4. Permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise shown or specified.
- I. Subbase Placement:
1. Provide subbase material where shown to the limits shown or indicated.
  2. Place subbase material in compacted lifts not exceeding depth of 6-inches each.
- J. Drainage Fill Placement:
1. Provide drainage fill material where shown to the limits shown or indicated.
  2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of 6-inches each. Compact lifts of drainage fill using suitable compaction equipment.
- K. Granular Fill Placement
1. Place granular fill on compacted, unscarified fill or subgrade.
- L. Compaction Density Requirements:
1. Compaction required for all types of fills shall be in accordance with Table 31 23 34-A of this Section. Moisten material or aerate the material as necessary to provide the moisture content that will facilitate obtaining the required compaction.
  2. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus 3-percent, with the following exceptions:
    - a. On-site clayey soils: Optimum to plus 3-percent.
  3. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated in Table 31 23 34-A.

**TABLE 31 23 34-A  
REQUIRED MINIMUM DENSITY**

Material	Percent Compaction (ASTM D698)	Uncompacted Lift (inches)
General Fill		
More than 5-feet below final grade	100	8
Less than 5-feet below final grade	95	8
Select Fill		
Below concrete slabs or mats	100	8
Below pavement and sidewalks	100	12
Behind concrete walls	95	8
Subbase Material		
Below pavement and sidewalks	100	12
All other locations	100	8
Drainage Fill	N/A	6
Structural Fill	98	-
Granular Fill	100	-
Landscaped Areas		
Subgrade	98	-
Topsoil	85	

4. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is specified in the “Field Quality Control” Article in Part 3.
5. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to Owner until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by Engineer) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

M. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with Table 31 23 34-A and the associated “Compaction Density Requirements” in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location

### 3.9 SITE GRADING

A. General:

1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Finished grades should be smooth and provide positive drainage.
  - a. Rough Grade Plus or minus 0.1 foot
  - b. Finish Grade Plus or minus 0.1 foot



2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Topsoil: The top 4-inches of soil in landscaped areas shall be topsoil.
  - C. Protection: Protect areas which have been graded from equipment traffic.
  - D. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free of irregular surface changes, and shall comply with the following:
  - E. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.
  - F. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than 1-inch above or below the required subgrade elevation.
  - G. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than ½-inch above or below the required subgrade elevation.
  - H. Grading Surface of Fill Under Concrete Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½-inch when tested with a 10-foot straight edge.
  - I. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

### 3.10 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

- A. Controlled Low Strength Materials Placement:
  1. Discharge CLSM from the mixer by reasonable means into the space to be filled.
  2. Bring the fill material uniformly up to the fill line indicated on drawings.
  3. Placement of fill over the CLSM may proceed after a curing period of not less than 3-days.

### 3.11 SITE PAVEMENT SUBBASE COURSE

- A. General:
  1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
  2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by Engineer.

- B. Undercutting: Undercutting, unless authorized by the Engineer, shall be replaced and compacted at the Contractor's expense. If the material, after excavation to subgrade, is found to be soft, spongy or unfit for use as subgrade, such unsuitable material shall be removed to a depth as directed by the Engineer and the subgrade shall be brought to proper elevation by filling with suitable material from excavation or from an approved borrow site.
- C. Grade Control:
  - 1. During construction, maintain lines and grades including crown and cross-slope of subbase course.
- D. Placing of Pavement Subbase Course:
  - 1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
  - 2. When indicated on the drawings, provide geotextile separation fabric over the prepared subgrade
- E. Compaction and Grade Control: Comply with compaction requirements for excavation and fill in this Section, and the following requirements:
  - a. Compaction with roller shall begin at the sides of the area to be paved and continue toward the center. Continue compaction until there is no movement of the course ahead of the roller.
  - b. After compaction of top lift of pavement subbase, provide and uniformly spread pipe bedding material and screenings compacted, on the surface, and sweep using gang-dragged broom, followed by compaction.
  - c. After rolling, check for grade with a line not less than 40-feet in length; depression over ½-inch deep shall be filled to satisfaction of Engineer.
  - d. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
  - e. Do not install pavement subbase in excess of 500-feet in length without compacting to prevent softening of the subgrade.
  - f. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

### 3.12 DISPOSAL OF EXCAVATED MATERIALS

- A. Unsuitable materials encountered in an excavation shall be removed by the Contractor and backfilled with suitable material and compacted. Unsuitable materials include organic soils, muck, soft and compressible silts and clays and running sands.
- B. Excavated materials not required for topsoil, fill or backfill shall be removed from the site of the work by the Contractor, but none shall be deposited on private property without written consent of the property owner.

### 3.13 TEMPORARY BARRIERS


- A. Provide temporary barrier surrounding excavations and excavation work areas to provide temporary protection to persons and property. Barrier shall have openings only at vehicular, equipment, and worker access points.
- B. Minimum Material Requirements for Temporary Barriers:
  - 1. Temporary barrier shall not be less snow fence-type fencing, 4-feet high.
  - 2. Fence shall be constructed of vertical hardwood slats measuring not less than 1-1/2 inches by 1/4 inch interwoven with strands of horizontal wire, or shall be of equivalent plastic construction.
  - 3. Posts:
    - a. Posts shall be steel, either "U"-, "Y"-, "T"-shaped, or channel section.
    - b. Posts shall have a nominal weight of not less than 0.33-pound per linear foot, exclusive of the anchor.
    - c. Posts shall have tapered anchors weighing not less than 0.67 pounds, each firmly attached by means of welding, riveting or clamping.
    - d. Posts shall have corrugations, knobs, notches, or studs placed and constructed to engage a substantial number of fence line wire in the proper position.
    - e. Provide each post with sufficient quantity of galvanized wire fasteners or clamps, of not less than 0.120 inch diameter, for attaching fence wire to post.

### 3.14 FIELD QUALITY CONTROL

- A. Field inspection, sampling and testing shall be performed.
- B. Site Tests: Owner will employ an independent testing laboratory to perform field quality control testing.
  - 1. Testing Laboratory Scope:
    - a. Perform field moisture content and density tests to ensure that the specified compaction of embedment and fill materials has been obtained.
    - b. Perform tests of actual unconfined compressive strength or bearing tests on structure subgrades.
    - c. Report results of each test to CFPUA, Engineer, and Contractor.
  - 2. Authority and Duties of Testing Laboratory:
    - a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings. When materials furnished or the Work performed does not comply, technician will direct attention of CFPUA, Engineer, and Contractor to such failure.
    - b. Technician will not act as foreman or perform other duties for Contractor. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements, or to approve any portion of the Work.
  - 3. Responsibilities and Duties of Contractor:
    - a. To facilitate testing laboratory, Contractor shall advise testing laboratory at least 2-days in advance of excavating filling operations to allow for assignment of personnel for field quality control testing.

- b. It shall be Contractor's responsibility to control construction operations to accomplish the specified compaction for fill and trench construction and confirm tests verify that Contractor has complied, and is complying relative to compaction control.
  - c. Contractor shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork:
    - 1) 200 linear feet of trench embedment and backfill.
    - 2) 10 cubic yards of select fill.
    - 3) 100 cubic yards of general fill.
    - 4) 50 cubic yards of subbase material.
  - d. Each test location shall include tests for each layer, type, or class of fill to finish grade.
4. Testing laboratory will inspect and indicate acceptable subgrades and fill layers using the interval/units listed below as a guide. Actual inspection and testing interval/units will vary based on specific project conditions.
- a. Trenches for pipelines and underground facilities (including buried ductbanks):
    - 1) In Open Fields: Two locations every 1,000 linear feet.
    - 2) Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
    - 3) Crossing Paved Roads: Two locations along each crossing.
    - 4) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
  - b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Engineer.
  - c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.
  - d. For General Fill: One per 1,000 square feet on every compacted lift.
  - e. Subbase Material: One per 1,000 square feet on every compacted lift.
5. Test reports shall be provided to Owner, Engineer and Contractor.
6. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, Contractor shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at Contractor's expense until subgrades, bedding, and fill are acceptable.

END OF SECTION

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**TABLE 1 Classes of Embedment and Backfill Materials**

Class	Type	Soil Group Symbol D 2487	Description	Percentage Passing Sieve Size			Atterberg Limits		Coefficients	
				1 1/2 in. (40 mm)	No. 4 (4.75 mm)	No. 200 (0.075 mm)	LL	PI	Uni. family $C_u$	Curve type $C_c$
IA	Manufactured Aggregates: open-graded, clean.	None	Angular, crushed stone or rock, crushed gravel, broken coral, crushed slag, cinders or shells, large void content; contain little or no fines.	100 %	<10 %	<5 %	Non Plastic			
IB	Manufactured, Processed Aggregates: dense-graded, clean.	None	Angular, crushed stone (or other Class 1A materials) and stone/sand mixtures. With gradations selected to minimize migration of adjacent soils; contain little or no fines (see X.3.3).	100 %	<50 %	<5 %	Non Plastic			
II	Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines.	100 %	<50 % of "Coarse Fraction"	<5 %	Non Plastic		>4	1 to 3
		GP	Poorly graded gravels and gravel-sand mixtures; little or no fines.				>4	<1 or >3		
		SW	Well-graded sands and gravelly sands; little or no fines.		>50 % of "Coarse Fraction"		>6	1 to 3		
		SP	Poorly graded sands and gravelly sands; little or no fines.				>6	<1 or >3		
	Coarse-Grained Soils, borderline clean to w/fines	eg. GW-GC, SP-SM	Sands and gravels which are borderline between clean and w/fines.	100 %	Varies	5 % to 12 %	Non Plastic		Same as for GW, GP, SW and SP	
III	Coarse-Grained Soils With Fines	GM	Silty gravels, gravel-sand-silt mixtures.	100 %	<50 % of "Coarse Fraction"	12 % to 50 %		<4 or <"A" Line		
		GC	Clayey gravels, gravel-sand-clay mixtures.					>7 and >"A" Line		
		SM	Silty sands, sand-silt mixtures.	>50 % of "Coarse Fraction"	>4 or <"A" Line					
		SC	Clayey sands, sand-clay mixtures.		>7 and >"A" Line					
IVA*	Fine-Grained Soils (inorganic)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity.	100 %	100 %	>50 %	>50	<4 or <"A" Line		
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.					>7 and >"A" Line		
IVB	Fine-Grained Soils (inorganic)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty silts, elastic silts.	100 %	100 %	>50 %	>50	<"A" Line		
		CH	Inorganic clays of high plasticity, fat clays.					>"A" Line		
V	Organic Soils	OL	Organic silts and organic silty clays of low plasticity.	100 %	100 %	>50 %	>50	<4 or <"A" Line		
		OH	Organic clays of medium to high plasticity, organic silts.					<"A" Line		
	Highly Organic	PT	Peat and other high organic soils.							

\*Includes Test Method D 2487 borderline classifications and dual symbols depending on plasticity index and liquid limits.  
 Note—"Coarse Fraction" as used in this table is defined as material retained on a No. 200 sieve.



## SECTION 33 01 12

### IDENTIFICATION FOR UTILITIES PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Underground Pipeline Detection and Warning.
  - a. Tracer wire system
    - 1) Vinyl/PVC adhesive tape.
    - 2) Polyethylene adhesive tape.
    - 3) Direct bury wire splice kits.
  - b. Tracer wire system testing
  - c. Metal detectable underground warning tape.
  - d. Marker posts.
2. Above Ground Piping and Valve Identification at CFPUA Facility Sites.
  - a. Tags
  - b. Applied pipe markers.

###### B. Related Requirements:

1. Section 09 91 00 - Painting and Coating: Execution requirements for painting specified by this Section.
2. Section 33 05 07.13 - Horizontal Directional Drilling: Materials and methods for piping and appurtenances.
3. Section 33 05 07.23 - Jacking and Boring: Materials and methods for carrier pipes and appurtenances.
4. Section 33 14 13 - Water Distribution Piping and Appurtenances: Materials and methods for piping and appurtenances.
5. Section 33 14 14 - Public Water Service Connections: Materials and methods for piping, valves, and appurtenances.
6. Section 33 14 13 - Water Distribution Valves, Fire Hydrants, and Backflow Prevention: Materials and methods for valves, and appurtenances.
7. Section 33 31 23 - Sanitary Sewer Force Mains, Valves and Appurtenances: Materials and methods for piping, valves, and appurtenances.
8. Section 40 71 00 - Magnetic Flow Meter
9. Section 43 21 39.13 - Submersible End Suction Pumps: Materials and methods for piping, valves, pumps, and other station equipment.

##### 1.2 REFERENCE STANDARDS

- A. NCGS 87-8A Underground Utility and Damage Prevention Act
- B. American Public Works Association: Uniform Color Code
- C. American Society of Mechanical Engineers: ASME A13.1 - Scheme for the Identification of Piping Systems.

### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog literature for each product required.

## PART 2 PRODUCTS

### 2.1 UNDERGROUND PIPELINE DETECTION AND WARNING

- 1. Tracer Wire
  - a. Vinyl/PVC adhesive tape.
  - b. Polyethylene adhesive tape.
- 2. Direct bury wire splice kits.
- 3. Metal detectable underground warning tape.
- 4. Refer to CFPUA Material Specification Manual (MSM) for the following products:

<b>MSM Section</b>	<b>Material</b>
K-Miscellaneous	Warning Tape
L-Electrical	Wire and splice kits

### 2.2 ABOVE GROUND PIPING AND VALVE IDENTIFICATION

- A. Above Grade Pipe Identification
  - 1. Color-Coding and Lettering Size: Conform to ASME A13.1.
  - 2. Applied Pipe Markers
    - a. Factory-fabricated, flexible, semi-rigid plastic.
    - b. Preformed to fit around pipe or pipe covering.
    - c. Larger sizes may have maximum sheet size with spring fastener.
  - 3. Applied Tape Pipe Markers
    - a. Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
  - 4. Stencils
    - a. Clean-cut symbols.
    - b. Letters:
      - 1) Up to 2-inch Outside Diameter of Insulation or Pipe === ½-inch high letters.
      - 2) 2-½- to 6-inch Outside Diameter of Insulation or Pipe == 1-inch high letters.
      - 3) Over 6-inch Outside Diameter of Insulation or Pipe == 1-¾-inch high letters.
      - 4) Stencil Paint: As specified in Section 099000 - Painting and Coating; semi-gloss enamel.
- B. Valves
  - 1. Plastic Tags
    - a. Laminated three-layer plastic with engraved letters on light, contrasting background color.
    - b. Minimum Tag Size and Configuration: 1-½ inch.
  - 2. Metal Tags
    - a. Stainless-steel construction; stamped letters.



- b. Minimum Tag Size and Configuration: 1-½ inch with finished edges.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Identify prescribed materials and color code for each pipeline type to be installed.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 09 90 00 - Painting and Coating for stencil painting.

### 3.2 INSTALLATION

- A. Buried Pipeline Detection and Warning
  - 1. Tracer wire system termination and access.
    - a. Tracer wire systems must be installed as a single continuous wire. No looping or coiling of wire is allowed.
    - b. All tracer wire termination points must be grade level/in-ground access boxes identified with "sewer" or "water" cast into the cap.
    - c. A minimum of 2 ft. of excess/slack wire is required in all tracer wire access boxes after meeting final elevation.
    - d. Runs without service laterals or hydrants shall provide intermediate tracer wire access at minimum 1,000-foot intervals and must be provided utilizing a grade level/in-ground access box located at the edge of the road right-of-way and outside the roadway surface.
    - e. Termination and access shall be installed as indicated on the Drawings for all pressure piping at the following locations:
      - 1) Cast iron boxes located at minimum 1,000-foot intervals
      - 2) All in-line valve boxes on water mains and services and on sewer force mains and services.
      - 3) At hydrant valve boxes and hydrants
      - 4) Water meter service boxes
  - 2. Tracer wire repairs
    - a. Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
  - 3. Tracer wire attachment and connections
    - a. Tracer wire shall be installed at the top half (11-1 o'clock position) of the pipe and secured (taped/tied) at 12-foot intervals.
    - b. Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead end and ground using an anode buried at the same depth as the tracer wire.
    - c. All service lateral tracer wires shall be a single wire, connected to the mainline tracer wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire.

- d. In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.
  - e. A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to ensure full tracing/locating capabilities from a single connection point.
  - f. Lay Mainline tracer wire continuously on the North or East side of valves and fittings.
  - g. Tracer wire on all service laterals must terminate at an approved tracer wire access located directly above the service lateral at the edge of road right of way.
  - h. Connect tracer wire using direct bury splice kits in accordance with manufacturer's recommendations
4. Tracer wire testing and verification
- a. Provide locating equipment to verify tracer wire locating system in presence of CFPUA or ENGINEER construction observer.
  - b. The test will take the following form:
    - 1) A standard 5-watt generator will be used to provide an AC current on the wire.
    - 2) The frequency of the signal from the generator will be initially restricted to 33 kHz or less.
    - 3) A standard hand-held detector will be used to trace the signal.
  - c. The installed tracer wire will be deemed to pass the test if using the above set up:
    - 1) The tracer wire is accessible at all access points.
    - 2) The tracer wire can be traced from access point to access point.
    - 3) Widely-spaced access points can be traced out in the worst-case from each end to a common meeting point between them.
    - 4) Depth readings are consistent and accurate to within a 15:1 depth to diameter ratio.
5. Horizontal Directional Drill and Bore/Jack Crossings
- a. Follow special tracer wire procedures identified in those specification sections.
- B. Buried Pipeline Metal Detectable Warning Tape
- a. For all diameter potable water mains (excluding 1-inch service lines) and all diameter sewerage force mains
    - 1) Install 1'-6" deep and directly above pipeline during backfilling operation.
- C. Above Ground Piping and Valve Identification at CFPUA Facility Sites:
1. Piping:
- a. Identify with plastic tape pipe markers or stenciled painting.
  - b. Apply stencil painting as specified in Section 09 90 00 - Painting and Coating.
  - c. Identify service, flow direction, and pressure.
  - d. Install in clear view and align with axis of piping.

- e. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
2. Valves:
- a. Install tags using corrosion-resistant chain.
  - b. Number tags consecutively by type and location.

END OF SECTION



SECTION 33 01 30.86  
MANHOLE RIM ADJUSTMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Raising manhole frames and covers.
  - 2. Replacing manhole frames and covers.
- B. Related Requirements:
  - 1. Section 33 05 13 – Precast Concrete Manholes and Utility Structures

1.2 REFERENCES

- A. CFPUA Material Specification Manual (MSM)

1.3 SUBMITTALS

- A. Product Data: Manufacturer information for manhole covers and riser rings construction, features, configuration, and dimensions.
- B. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials according to manufacturer instructions.
- B. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

1.5 FIELD CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 MATERIAL SPECIFICATION MANUAL

- A. Refer to CFPUA Material Specification Manual (MSM) for the following products:

MSM No.	Product
---------	---------

I	Manhole Casting/ Standard Ring and Cover
K	Manhole Casting Adjustment Rings/ HDPE
N	Concrete/ Non-Shrink Grout, Type S Mortar

## 2.2 RISER RINGS

- A. Clay Brick Units:
  - 1. Description:
    - a. Solid units.
    - b. Comply with ASTM C32 or AASHTO M91.
- B. Precast circular rings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify and locate manholes requiring grade adjustment.

### 3.2 INSTALLATION

- A. Raising Manhole Frames and Covers:
  - 1. Locate and raise manholes to grade as indicated.
    - a. Cone Sections:
      - 1) Do not adjust elevation greater than 8 inches without addition of a new manhole section.
      - 2) Use no more than three courses (8 inches) of brick or precast concrete riser rings to achieve indicated elevation for frame and cover.
    - b. Flat Top Manholes:
      - 1) Shall not be adjusted more than a single course of brick (4 inches).
- B. Replacing Manhole Frames and Covers:
  - 1. Locate manholes for replacement of frames and covers as indicated.
  - 2. Deliver removed manhole frames and covers to Owner as maintenance materials.
  - 3. Install new frames and covers for manholes as indicated.
  - 4. Adjust new frames and covers to match finished grade as indicated.
  - 5. Seal joints between manholes and manhole frames.
- C. Paving Restoration:
  - 1. Restore bituminous paving areas as specified.
- D. Landscaping Restoration:
  - 1. Restore grassed areas as specified.

END OF SECTION

SECTION 33 05 05.31  
HYDROSTATIC TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Hydrostatic testing of pressure piping.
- B. Related Requirements:
  - 1. Section 33 31 23, Sanitary Sewer Force Mains, Valves and Appurtenances: Pipe materials and accessories normally encountered with municipal sanitary sewage force mains.
  - 2. Section 33 14 13, Water Distribution Piping, Valves, Hydrants and Appurtenances: Pipe materials and accessories normally encountered with pressurized water distribution systems.

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
  - 1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. The foreman of the contracting crew must speak fluent English.
- B. Any event requiring a CFPUA representative to be present will require a minimum of two (2) business day notice to schedule the event.
- C. No valves are to be operated unless a CFPUA representative is present. Any valves operated without a CFPUA representative present or a directive may be subject to penalties in accordance with CFPUA's Ordinance.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittals.
- B. Submit following items prior to start of testing upon request:
  - 1. Testing procedures.
  - 2. List of test equipment.
  - 3. Testing sequence schedule.
  - 4. Provisions for disposal of flushing and test water.
  - 5. Certification of test gage calibration.
- C. Test and Evaluation Reports: Indicate results of piping tests.
- D. Qualifications Statement:
  - 1. Submit qualifications for applicator upon request.

## PART 2 PRODUCTS

### 2.1 HYDROSTATIC TESTING

- A. Equipment:
  - 1. Pressure pump.
  - 2. Pressure hose.
  - 3. Water meter.
  - 4. Test connections.
  - 5. Pressure relief valve.
  - 6. Pressure Gage: Calibrated to 0.1 psi.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00, Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that piping and appurtenances are installed and ready for testing.
- C. Verify that trenches are backfilled.
- D. Verify that pressure piping thrust restraints have been installed. Where any section of piping is provided with concrete thrust blocking, the hydrostatic test shall not be made until at least 5 days after installation of the concrete thrust blocking unless otherwise approved.

### 3.2 FIELD QUALITY CONTROL

- A. Section 01 70 00, Execution and Closeout Requirements.
- B. Testing of Pressure Piping to be performed according to AWWA C600 and the following:
  - 1. Hydrostatic testing procedure:
    - a. Testing shall be performed in the presence of the CFPUA representative. Testing shall be scheduled with CFPUA a minimum of two business days in advance and shall not proceed until granted approval by CFPUA. The contractor will pre-test the lines prior to the CFPUA representative arrival. The contractor is to cancel the test if the lines will not pass the required test, correct all visible leakage, and locate and repair leakage in lines which exceeds the specified amounts. When completed, the contractor will re-schedule the test.
    - b. Slowly fill with clean potable water portion of piping to be tested, expelling air from piping. Fill and test mains and services.
    - c. Close air vents after air is expelled.



- d. Raise pressure to specified test pressure. For purposes of testing, working pressure shall be 100 psi and test pressure shall be 150 psi. The pressure gauge must be liquid filled with 2 psi increments maximum. The gauge must be a minimum of three feet above grade. No more than 3 psi can be lost during the two-hour test. The gauge must return to 0 psi when the test is completed. There will be no allowable leakage. Air testing will not be accepted on mains and services, but will be accepted for tapping sleeves, 40 psi for 15 minutes or hydrostatic testing @150 psi for 15 min with zero pressure loss for both.
- e. Observe joints, fittings, and valves undergoing testing.
- 2. Hydrostatic Testing Requirements for Pipe Burst Installations
  - a. Subject pipe burst installations to a pressure test before connecting to direct bury mains. Testing shall be performed in the presence of the CFPUA representative. Testing shall be scheduled with CFPUA a minimum of two business days in advance and shall not proceed until granted approval by CFPUA.
  - b. The pipe shall be filled with clean potable water and pressurized to 1.5 times the working pressure at the point of testing with a minimum of 150 psi, for a period of no less than 24 hours and then subjected to the specified test pressure.
  - c. Pretest pipe burst installations for a period of 2 hours before notifying CFPUA that the main is ready for a final pressure test. No final pressure test shall begin after 2:00 pm.
  - d. Perform testing as follows:
    - 1) Test pressure shall be at least 1.5 times the working pressure at the point of testing with a minimum of 150 psi. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. Test pressure shall not exceed the pipe or thrust restraint design pressure. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
    - 2) The pressure test duration shall be 2 hours.
    - 3) Ensure that the pipe is full of water and that the air has been removed before testing.
  - e. Pressure testing is the responsibility of the Contractor, who shall provide materials, labor, and equipment.
- 3. If testing of piping and appurtenances indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within acceptable limits.
- 4. Correct visible leaks regardless of quantity of leakage.

END OF SECTION



## SECTION 33 05 07.23

### JACKING AND BORING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. SCOPE:

1. Design, furnish and install the proposed piping alignment by jacking and boring construction methods, as shown on the drawings and conform to this specification. The work includes, but not limited to, survey, design, excavation, dewatering, removal of all materials encountered in the jacking and boring operations, disposal of all material not required in the work, grouting bulkheads, testing, cleaning, restoration, and incidentals as shown on the drawings and as specified herein.
2. The jacking and boring construction method shall consist of pushing (jacking) the casing pipe into the earth with a boring auger rotating with the casing/pipe to remove the spoil. The operations are to be completed while simultaneously providing ground stabilization techniques. The method shall include provisions for preventing uncontrolled inflow of loose or saturated soils.
  - a. Contractor is responsible for completing any additional geotechnical/subsurface investigations required to establish the appropriate parameters (i.e., limiting pressures, setback distances, depth of cover, etc.) for completing the design of the jacking and alignment, as specified herein.
  - b. Owner is responsible for obtaining the required general construction permits, easements and approvals, from the NCDOT or railroad agency. When encasement pipe is installed in the State right-of-ways the entire installation shall be as required by NCDOT. Where encasement pipe is installed in Railroad right-of-ways the entire installation shall be as required by the appropriate railroad agency. Where encasement pipe is installed across rivers, the entire installation shall be as required by USACE/NCDEQ. Where encasement pipe is installed in the City of Wilmington right-of-ways the contractor will pay and be responsible for obtaining the permits.
3. General:
  - a. Be responsible for the final design and constructed product, furnishing the design data, obtaining approval from agencies and for the safety of the operations and for personnel engaged in the work.
  - b. Be responsible for furnishing the qualified labor and superintendence necessary for this method of construction.
  - c. Furnish all items necessary to perform the jack and boring, and construct both the casing and carrier piping to the lines and grade shown on the drawings.
  - d. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the jack and bore, or tunneling installations.
  - e. Any modifications, damages or detrimental consequences to the existing ground conditions, structures, facilities or utilities as a result of the Contractor's Work shall be repaired and restored to its original condition as directed by the Engineer at no additional cost to the owner.

4. Coordination:
  - a. Review installation procedures under other Sections and other contracts and coordinate with the Work that is related to this Section.
  - b. Be responsible for coordinating construction activities with the respective authorities.
5. Related Sections:
  - a. Section 32 92 01 – Seeding and Sodding.
  - b. Section 31 23 34 – Excavation, Trenching, Dewatering, and Backfilling.
  - c. Cape Fear Materials Specification Manual for the following materials:
    - 1) Ductile Iron Pipe.
    - 2) PVC C-900

## 1.2 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with the NCDOT, Cape Fear Public Utility Authority, City of Wilmington (COW), public agencies, and owners of public utilities or other facilities.

## 1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
  1. American Railway Engineering Association: Specifications, Part 5; Pipeline - Crossings Under Tracks or Located on Railroad Property - For Flammable and Nonflammable Substances.
  2. Steel casing pipe conforming to ASTM A-139 and AWWA C200.
  3. Carrier piping, Ductile Iron Pressure Class 250, ANSI/ AWWA C151/A21.51, installation per ANSI/AWWA C600.
  4. Latest edition of ASTM D1248, ASTM D3350, ASTM F-714.
- B. All supervisory personnel must be adequately trained and will have at least ten years of experience in jack and boring operations. Contractor will have to submit the names and resumes of all supervisory field personnel prior to the start of construction.
- C. Materials and methods of construction used on railroad property shall be subject to the approval of the specific railroad company. Contractor to conduct work operations fully within the railroad company rules, regulations, and requirements.

## 1.4 SUBMITTALS

- A. Engineer will base the review of submitted details and data on the requirements of the completed work, safety of the work in regard to the public, potential for damage to public or private utilities and other existing structures and facilities, and the potential for unnecessary delay in the execution of the work. Such review shall not be construed to relieve the Contractor in any way of his responsibilities under the contract.
- B. Contractor shall not proceed with field activities until the required drawings and submittals are reviewed and accepted by the Engineer.

- C. Prepare and submit to the Engineer and Owner for review and approval no less than 20 days prior to starting the bore:
  - 1. Jacking and Boring Plan describing the equipment, methods, operational procedures, construction sequence, contingency plans, and other items of concern to be performed during the jacking and boring construction.
  - 2. Project Safety Plan.
  - 3. Submit site layout, equipment arrangement, and entry/exit pits drawings and technical specifications of the machine and equipment (including any modifications) proposed.
  - 4. Construction drawings, Specifications, and Contingency plans shall be submitted on the following items:
    - a. Complete details of the site clearing, excavation, drainage, security, and equipment mobilization including, but not limited to, the methods, procedures and equipment arrangement to be used during the construction.
    - b. Complete details, drawings, and calculations signed and seal by an Engineer licensed in the state of North Carolina, of the significant factors and constraints associated with jacking and boring installations including, but not limited to, fluid pressures, jacking forces, pipe capacities, jacking and receiving pits shoring design, etc.
    - c. Provide plan and profile of the proposed jacking and boring alignments, indicating depth, angle of deflection, and radius of all pipe bends along the alignment.
    - d. Complete details of the grouting techniques/methods to be utilized for filling grout into the annulus between the adjacent soils and the outside of the casing piping, including but not limited to, fitting procedures, equipment, pumping procedures, fluid pressures, mixtures and plug systems. Also include methods of monitoring and controlling the grouting pressures.
    - e. Method of monitoring and controlling the specified line and grade of excavation including, but not limited to, the methods, procedures, reliability, and necessary ancillary equipment to be used during construction operations.
    - f. Complete details of the groundwater control, launching seals, muck/spoils containment, dewatering, drying, and removal including, but not limited to, the methods, procedures, equipment, contingency plans and off-site disposal location.
    - g. Complete details of the casing and carrier piping capacities, maximum jacking loads, storage, assembly, and installation including, but not limited to, the methods, procedures, and equipment to be used.
- D. Quality Control Methods: At least 10 days prior to the start of the jacking and boring submit a description of his quality control methods he proposes to use during the operations to the Engineer. The submittal shall describe:
  - 1. Procedures for controlling and checking line and grade.
  - 2. Field forms for establishing and checking line and grade.
- E. Safety: Procedures including, but not limited to, monitoring for gases encountered shall be submitted.
- F. Hazardous chemical list as well as all MSDS and technical data sheets.

- G. Contractor must demonstrate expertise in "trenchless" methods by providing a list of five (5) utility references for which similar work has been performed in the last two years. The references should include a name and telephone number where contact can be made to verify the Contractor's capability. The Contractor must provide documentation showing successful completion of the projects used for reference. Conventional trenching experience will not be considered applicable.
- H. Have completed jacking and boring casing installations of same diameter or larger and have successfully completed lengths equal to the drawings or longer, crossings of railroads, and crossings of major state roads. Provide documentation in qualification submittal.
- I. Contractor is required to bring to the attention of the Engineer any known discrepancies with actual jacking and boring methods that the Contractor will be performing. This shall be stated, in writing, to Engineer no later than the pre-construction meeting.
- J. As-Built Drawings:
  - 1. Submit As-built documentation to Engineer and Owner within 7 days of the drill operation.

## 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work.
- B. Handle all pipe, fittings, specials and accessories carefully with approved handling devices. Handling devices shall include ropes, fabric, or rubber-protected slings and straps. Chains, cables, or hooks inserted into the pipe ends shall NOT be used. Two slings spread apart shall be used for lifting each length of pipe. Do not drop or roll material off trucks.
- C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Pipe supports shall be spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the supports.
- D. Stacking of pipe shall be limited to a height that will not cause deformation of the bottom pipes under anticipated temperature conditions.
- E. All ends of stored piping shall be securely capped/plugged to prevent entry of soil, debris, and vermin.

## PART 2 PRODUCTS

### 2.1 JACK AND BORING SYSTEM, GENERAL:

- A. The jack and boring system shall consist of, but not limited to, the following components:
  - 1. Jacking system suitable for forcing the casing through the embankment.
  - 2. Auger Boring and Spoil removal system.

3. Pipe lubrication system.
- B. Jacking and Boring over-cut shall not exceed ½-inch on the outside radius of the casing pipe being installed.
  - C. The excavation equipment and system shall be fully capable of excavating and removing all material that will be encountered during the construction operations.
  - D. The automated spoil transportation system shall match the excavation rate to the rate of spoil removal, maintaining settlement or heave within tolerances specified herein.
    1. If a slurry spoil transportation system is used, the groundwater pressure may be managed by use of the slurry pumps (which may be variable speed), pressure control valves and a flow meter. A slurry bypass unit shall be included in the system to allow the direction of flow to be changed and isolated, as needed. A solids separation process shall be provided when using slurry transportation systems. The process shall be designed to provide adequate separation of the spoil from the slurry so that the clean slurry can be returned to the cutting head for reuse.
    2. If an Auger spoil transportation system is utilized, the groundwater pressures may be managed by controlling the volume of spoil removal with respect to the advance rate (Earth Pressure Balance Method) and the application of compressed air. In soils with excessive groundwater, approval of the Engineer shall be required for the earth pressure balance auger systems. Approval shall be based on the evaluation of the equipment's ability to balance soil and groundwater pressures at the face, stability of the soils and the significance of the groundwater present.
    3. Contractor to identify and submit for approval the type of separation system to be used.
  - E. Pipe Jacking Equipment:
    1. The main jacks shall be mounted in a jacking frame and located in the drive (starting) shaft. The jacking frame successively pushes the steel casing pipes toward a receiving shaft. The jacking capacity shall be sufficient to push the auger/boring machine and/or length of casing piping through the ground.
    2. The main jacking equipment installed shall have a capacity greater than the anticipated jacking load. The hydraulic cylinder extension rate shall be synchronized with the excavation rate of the boring, which shall be determined by the specific soils conditions.
    3. Provide intermediate jacking stations when the total anticipated jacking force needed to complete the installation exceeds the designed maximum jacking force of the pipe.
  - F. Pipe Lubrication System:
    1. A pipe lubrication system may be utilized when anticipated jacking forces on the pipe are expected to exceed the capacity of the main jacks or exceed the pipe design strength with the appropriate safety factor. A prior approved lubricant shall be injected at the rear of the auger, or boring machine and, if necessary, through the casing pipe walls to lower the friction developed on the surface of the pipe during jacking and thereby reduce the jacking forces.

## 2.2 MATERIALS

- A. Refer to the CFPUA Materials Specification Manual for a list of applicable materials including:
1. Piping used for the conveyance of water, wastewater, and non-potable water, including:
    - a. Ductile Iron Pipe: All ductile iron carrier pipe installed with joint inside an encasement pipe must utilize rigid restrained joints.
      - 1) A - Ductile Iron Pipe/ Restrained Push- On Joint/ TR Flex Joint (4" thru 36")
      - 2) A - Ductile Iron Pipe/ Restrained Push- On Joint/ Flex- Ring Joint (4" thru 36")
      - 3) A - PVC Pipe Restrained Joint Pipe & Couplings C – 900 (4" thru 12")
  2. Casing Pipe
    - a. Use only new, welded or seamless steel pipe per ASTM A-139, Grade B. Casing minimum thickness to be 0.625-inches, or as required by the site-specific regulatory agencies or property owner. The casing wall thickness shall be designed to accommodate the maximum jacking load allowed, as well as the expected earth and live loads. Be fully responsible for the sufficiency of the casing thickness provided.
    - b. Joints in steel casing pipe shall be butt-welded joints, conforming to the requirements of AWWA C206. Pipe 36 inches in diameter and larger shall be welded both inside and outside of the pipe/casing.
    - c. After welding, the joint and the surrounding damaged or uncoated area shall be coated with the same material and to the same thickness as the shop applied coating.
    - d. All steel casing pipe and welds shall meet or exceed either the site specific regulatory agency's requirement, or the manufacturer's minimum wall thickness to meet or exceed the greater of either: installation (jacking), loading, or carrier load requirements.
    - e. The size (diameter) of the steel casing shall be in accordance with the table below. Larger encasement pipe sizes may be substituted upon per-approval or as directed by the Engineer or Owner.

Carrier Pipe OD	Encasement Pipe OD	Roadway Encasement Thickness	Encasement Pipe ID	Railroad Encasement Thickness	Encasement Pipe ID
6", 8", 10"	16"	0.250"	15.5"	0.281"	15.438"
12", 14", 16"	24"	0.250"	23.5"	0.375"	23.25"
18", 20"	30"	0.312"	29.376"	0.469"	29.062"
24"	36"	0.375"	35.25"	0.531"	34.938"
30"	42"	0.500"	41"	0.625"	40.75"
36"	48"	0.500"	47"	0.688"	46.624"

Exceptions to encasement pipe requirements shall be as shown on the drawings.

- f. All steel pipes shall be designed for the external and internal loads to which they will be subjected. Steel casing shall meet ASTM specifications and be designed to meet or exceed a minimum live load of a Cooper E-80 loading. The loading consists of 80 kip (356 kN) axle loads spaced 5-feet (1.5 m) on centers.
- g. K - Casing Insulators / Stainless Steel



- h. Casing End Seals:
  - 1) Seal each end of casing pipe with brick and Type @ Mortar.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### A. General:

1. Comply with the lawful requirements of the North Carolina Department of Transportation, Cape Fear Public Utility Authority, public agencies, and owners of public utilities or other facilities respecting the safeguarding of structures and improvements that might be endangered by the jacking and boring, or microtunneling construction operations.
2. Install the required steel casing by means of jacking and boring, specified herein, and as recommended by the pipe manufacturer.
3. The jacking and boring, along with the installation of the casing pipe shall be done simultaneously and continuously until the casing pipe is in final position.
4. Be responsible for his means and methods of jacking and boring, and shall ensure the safety of the work, the Contractor's employees, the public, and adjacent property, whether public or private.
5. Maintain traffic flow at all times during the progress of the work. Provide adequate signs, barricades, flag persons, lights and other control devices in accordance with the provisions and requirements of the North Carolina Department of Transportation or City of Wilmington standards. No lanes of traffic shall be closed without prior approval.
6. Contractor to provide erosion and sediment control to minimize erosion and the transport of sediment beyond the limits of the work area.
7. Anticipate that portions of the jacking and boring will be below the groundwater table and dewatering will be required.
8. Comply with all local, state, and federal laws, rules, and regulations at all times to prevent pollution of the air, ground, and water.
9. Locate, mark and protect existing utilities and facilities in the work area. Perform test pits as required.
10. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from Engineer in writing, before proceeding.

#### B. Jacking and Boring Operations:

1. Provide and maintain adequate boring equipment and install support systems as required.
2. The boring operations shall be progressed on a 24-hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the casing pipe has reached the receiving pit, unless identified otherwise by state agency's permit.
3. The boring operations shall consist of excavating the embankment material ahead of the casing, remove excavated material through the pipe and force the pipe through the embankment with jacks into the spaced provided. No jetting, sluicing, or wet boring is permitted.
4. All surfaces shall be smooth and uniform without bulges, dents, or warping of lengths, and only new pipe shall be used.

5. Finished lengths of pipe shall be furnished with beveled cut ends to facilitate proper welding of transverse joints. The diameter and wall thickness of the pipe shown on the drawings is the minimum required and no extra compensation shall be claimed by the Contractor if a larger and thicker pipe is used. Contractor is responsible in the event that the casing does buckle or collapse during these operations.
6. The over-cut by the cutting head shall not exceed the outside diameter of the casing pipe by more than ½-inch.
7. Required launching and receiving pits/shafts shall be excavated and maintained to the minimum dimensions necessary to perform the operations and allow for safe working practices.
8. The pits or shafts shall be adequately barricaded, sheeted, braced, dewatered, and ventilated as required, in accordance with applicable specifications and regulations.
9. Contractor to use thrust blocks designed to distribute loads in a uniform manner so that any deflection of the thrust block is uniform and does not impart excessive load on the shaft itself or cause the jacking frame to become misaligned.
10. Position jacks so that the resultant force is applied along the centerline of the casing pipe, and force is applied evenly to the entire end of the pipe.
11. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage.
12. Contractor to monitor and control the jacking pressure/force applied to ensure that pipe manufacturer's recommended limits are not exceeded.
13. Contractor responsible for all testing, survey, and documentation of the pre/post construction site conditions, in which to provide as a basis of comparison for the post construction conditions to be evaluated.
14. Once jacking has begun, the operation must continue without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

C. Steel Casing Installation

1. The installation of the casing shall be in accordance with manufacturer's recommendations and subject to the approval of the agency having jurisdiction.
2. The casing pipe shall be adequately protected to prevent crushing or other damage under the jacking pressures. Provide timbers for cushioning between the pipe pushed end and the jacking equipment.
3. The casing installation shall not produce upheaval, settlement, cracking, movement of the road.
4. Install casing piping concurrent with the bore, as earth is removed.
5. Surplus and unsuitable excavated material shall be disposed of by the Contractor.

D. Carrier Pipe Installation

1. All joints of the carrier piping, within the casing shall be restrained in accordance with the Section 33 31 23 – Sanitary Sewer Force Mains, Valves and Appurtenances.
2. Clean all dirt and debris from the casing piping.
3. Attach the centered/restrained casing spacers/guides to the carrier pipe sections, as required to prevent excessive sag, bending, shear stress and to support the pipe barrel in accordance with pipe manufacturer's recommendations. Piping is NOT to be supported by bells/joints.

4. A spacer shall be placed such that it supports the carrier pipe within 2 feet of the casing ends and a minimum of three spacers per 20-foot pipe section. For pipe sections, longer or shorter than 20 feet, follow the manufacturer's instructions and recommendations.
  5. Lubricant for pipe guides shall be drilling mud or flax soap. Petroleum, or Oil based products are NOT allowed.
  6. Protect and preserve the interior surfaces of the steel casing from damage.
  7. Contractor to provide brick casing end seals.
  8. K - Tracer wire shall be continued through casing.
- E. Transitions from One Type of Pipe to Another:
1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

END OF SECTION



## SECTION 33 05 09.33

### THRUST RESTRAINT FOR UTILITY PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe joint restraint systems for all pressurized mains (water and wastewater force).
  - 2. Includes fittings, valves, dead-ends, and other locations where change in pipe direction requires joint restraint.
  
- B. Related Requirements:
  - 1. Section 33 05 05.31 – Hydrostatic Testing of Water Distribution and Sanitary Sewer Force Mains: Materials and methods for pipeline cleaning and testing.
  - 2. Section 33 05 07.13 - Horizontal Directional Drilling: Materials and methods for piping and appurtenances.
  - 3. Section 33 05 07.23 - Jacking and Boring: Materials and methods for carrier pipes and appurtenances.
  - 4. Section 33 14 13 - Water Distribution Piping and Appurtenances: Materials and methods for piping and appurtenances.
  - 5. Section 33 14 13 - Water Distribution Valves, Fire Hydrants, and Backflow Prevention: Materials and methods for valves, and appurtenances.
  - 6. Section 33 31 23 - Sanitary Sewer Force Mains, Valves and Appurtenances: Materials and methods for piping, valves, and appurtenances.
  - 7. Section 40 95 01 - Duplex Submersible Wastewater Pumping Stations: Materials and methods for piping, valves, pumps, and other station equipment.

##### 1.2 REFERENCE STANDARDS

- A. American Water Works Association:
  - 1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
  
- B. ASTM International:
  - 1. ASTM A536 – Standard Specification for Ductile Iron Castings.

##### 1.3 COORDINATION

- A. General – Coordinate Work of this Section with the installation and modification of pressure main valves, bends, reducers, and dead-end fittings and pipe joints that require restraint.
  
- B. Joint Restraint Systems – Field or factory applied joint restraint systems shall be used unless otherwise indicated by the ENGINEER. When multiple valves, bends, fittings are in close proximity, ENGINEER to design adequate total restraint length required for fitting combination(s). The combined fitting restrained length total must equal the

sum of the individual fitting restrained lengths. Individual restrained end lengths applied to combined fitting end lengths can result in failure during testing or operation.

- C. Thrust Blocks – Concrete thrust blocking shall only be used when required for special installations, such as such as cut-in tees, tapping sleeves, plugged/capped sections removed from service, or other situations that would require retrofitting an existing service pipeline with joint restraints. ENGINEER shall design adequate size and weight of blocking to be installed for special installations.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer catalog information for restrained joint details and installation instructions.
- B. Shop Drawings:
  - 1. Indicate restrained joint details and materials being used.
  - 2. Submit schedules showing restraint device models and locations to be installed.
  - 3. Include restrained joint installation procedures.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record locations of joint restraints on design plan and profile drawings by begin and end station as proceeds daily and transfer field data to final record drawing submittal.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to AWWA 600 standards and manufacturer instructions.
- B. Perform pressure testing according to Section 33 05 05.31 – Hydrostatic Testing of Water Distribution and Sanitary Sewer Force Mains.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Provide pressure pipelines (water and force mains) with restrained joints and/or blocking at any change in direction including hydrant assemblies, bends, tees, reducers, blow-offs, dead-end mains, cut-in tees, tapping sleeves, etc. Thrust restraint shall be designed for a minimum pressure of **150 psi** at the lowest elevation in the pipeline test section.

### 2.2 JOINT RESTRAINT SYSTEMS

- A. Refer to CFPUA Material Specification Manual (MSM) for the following products:

<b>MSM Section</b>	<b>Material</b>
C	Joint Restraints

- B. Unless otherwise indicated, joint restraint systems may be factory or field applied systems.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify location of piping restraint locations in advance of pipe laying operations.
- B. Verify that pipe and fittings identified for restraint are ready to receive Work and the correct restraint device is applied to that location.
- C. Field measure and verify pipe restraint lengths indicated on drawings for Work to be installed.

### 3.2 PREPARATION

- A. Clean surfaces of pipe and fittings that are to receive joint restraint systems.

### 3.3 INSTALLATION

- A. Install joint restraint system such that joints are mechanically locked together to prevent joint separation in accordance with the manufacturer recommendations.
- B. In special installations where concrete thrust blocking is required, allow 7-day minimum cure time before placing pipe pressure load on concrete blocking.

END OF SECTION





## SECTION 33 05 13

### PRECAST CONCRETE MANHOLES AND UTILITY STRUCTURES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories.
- B. Related Sections:
  - 1. CFPUA Material Specification Manual (MSM)
  - 2. Section 01 51 00 – Bypass Pumping.
  - 3. Section 03 05 00 – Concrete.
  - 4. Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.
  - 5. Section 33 01 30.86 – Manhole Rim Adjustment.
  - 6. Section 33 14 22 – Testing of Sanitary Sewer Mains and Manholes.
  - 7. Section 33 31 1 – Sanitary Sewer Gravity Mains.
  - 8. Section 33 32 23 – Sanitary Sewer Force Mains, Valves and Appurtenances.

##### 1.2 REFERENCE STANDARDS

- A. American Association of State Highway Transportation Officials:
  - 1. AASHTO M91 – Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
  - 2. AASHTO M306 – Standard Specification for Drainage, Sewer, Utility, and Related Castings.
- B. American Concrete Institute:
  - 1. ACI 530 – Building Code Requirements and Specification for Masonry Structures.
- C. ASTM International:
  - 1. ASTM A48 – Standard Specification for Gray Iron Castings.
  - 2. ASTM A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM C32 – Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
  - 4. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
  - 5. ASTM C497 – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
  - 6. ASTM C877 – Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
  - 7. ASTM C913 – Standard Specification for Precast Concrete Water and Wastewater Structures.
  - 8. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

### 1.3 QUALITY ASSURANCE

- A. Perform Work according to ASTM and AASHTO standards and manufacturer's instructions.

### 1.4 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Furnish a one-year manufacturer's warranty for concrete manholes and structures.

### 1.5 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Submittals:
  - 1. Section 01 70 00 – Execution and Closeout Requirements.
  - 2. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.
  - 3. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
  - 4. Shop Drawings:
    - a. Indicate structure locations and elevations.
    - b. Indicate sizes and elevations of piping, conduit and penetrations.
  - 5. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
  - 6. Qualifications Statement: Submit qualifications for manufacturer.
  - 7. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

### 1.6 SITE CONDITIONS

- A. DELIVERY, STORAGE, AND HANDLING
  - 1. Section 01 60 00 – Product Requirements.
  - 2. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
  - 3. Handling: Comply with precast concrete manufacturer instructions and ASTM C913 for unloading and moving precast manholes and drainage structures.
  - 4. Bent Reinforcing steel bars are not permitted for use as lifting devices.
  - 5. Lifting devices shall be evaluated and approved by the Engineer.
  - 6. Storage:
    - a. Store materials according to manufacturer instructions.
    - b. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
    - c. Repair property damaged from materials storage.
  - 7. Protection:
    - a. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
    - b. Provide additional protection according to manufacturer instructions.

- B. EXISTING CONDITIONS
  - 1. Field Measurements:
    - a. Verify field measurements prior to fabrication.
    - b. Indicate field measurements on Shop Drawings.

**PART 2 PRODUCTS**

**2.1 MATERIAL SPECIFICATION MANUAL**

- A. Refer to CFPUA Material Specification Manual (MSM) for the following products:

MSM Section	Product
I	Castings and Access Covers
M	Coatings and Sealants
O	Structures

**2.2 SOURCE QUALITY CONTROL**

- A. Section 01 40 00 – Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.
- C. Verify that items provided have met factory testing requirements and are inspected upon delivery.
- D. Certificate of Compliance:
  - 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

**2.3 MATERIALS AND ACCESSORIES**

- A. Lining Systems
  - 1. MSM Section M – Coatings and Sealants
  - 2. Sewerkote Duramer 1030
  - 3. Zebron 386
  - 4. NeoPoxy NPR-5300
  - 5. Raven Lining System 405
  - 6. Warren Environmental S-301
  - 7. Sherwin-Williams SherFlex Elastomeric
  - 8. Sherwin Williams Dura-Plate 6100
  - 9. SpectraShield Liner Systems
- B. Grouts
  - 1. MSM Section N - Concrete
  - 2. Section 03 05 00 - Concrete

- C. Sewer Guards
  - 1. Stainless steel straps, anchors and sewer guards required at all Manholes.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are properly sized and located.
- C. Verify that built-in items are in proper location and are ready for roughing into Work.
- D. Verify that excavation base is ready to receive Work and excavation dimensions and elevations are as indicated on Drawings.

### 3.2 PREPARATION

- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.
- C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.
- D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

### 3.3 INSTALLATION

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- B. Correct over-excavation with Class 1 aggregate.
- C. Remove large stones or other hard matter impeding consistent backfilling or compaction.
- D. Protect manhole and structures from damage or displacement while backfilling operation is in progress.
- E. Excavating:
  - 1. As specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling and in indicated locations and depths.

2. Provide clearance around sidewalls of manhole or structure for construction operations.
3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Engineer.

F. Base and Alignment:

1. Install manholes and structures supported at proper grade and alignment on compacted crushed-stone bedding or piles as indicated on Drawings.
2. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.
3. Form and place manhole or structure cylinders plumb and level, to correct dimensions and elevations.

G. Coating:

1. Structure shall be painted with two coats of bituminous interior coating system at a rate of 120 square feet per gallon for each coat.
  - a. Prior to testing wet well shall be coated. See MSM Section M – Coatings and Sealants.

H. Precast Concrete Manholes:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Assembly:
  - a. Assemble multi-section manholes and structures by lowering each section into excavation.
  - b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
  - c. Lower, set level, and firmly position base section before placing additional sections.
4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed manholes and structures meet required alignment and grade.
8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
9. Cut pipe flush with interior of structure.
10. Shape inverts through manhole and structures as indicated on Drawings.

I. Grouting:

1. Section 03 05 00 – Concrete
2. Verify all surfaces have been inspected and prepared for application. All surfaces shall be free of dirt, oil, grease and other contaminants.
3. Surface shall be clean, sound and roughened to ensure a sufficient bond.

4. Surface shall be saturated up to 24 hours prior to application but free of standing water at the time of application.
5. Provide sufficient support for items to be embedded into the work. Diagrams, templates and other forms can be used to properly locate such items.
6. Refer to Manufacturer's instructions for proper grouting application and installation.
7. Application shall be inspected immediately after and any defects repaired or removed for re-installation if directed by the Engineer.

J. Castings:

1. Set frame and cover at finished grade for manholes and other structures with covers located within unpaved areas and graded away from cover.
2. Set frames using mortar and masonry as indicated on Drawings.
3. Lay concrete brick in full bed of mortar and completely fill joints.
4. If more than one course of concrete brick is required, stagger vertical joints.

K. Backfilling: As specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.

1. All structures shall be leak tested prior to backfilling.

### 3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Requirements.

B. Testing:

1. Perform testing in accordance to ASTM C497.
2. Concrete Manhole Sections: As specified in Section 33 14 22 – Testing of Sanitary Sewer Mains and Manholes.
3. Conduct a visual inspection of concrete structures.
4. Repair all visible and detectable leaks.
5. Leakage testing for structures shall be performed prior to backfilling by the following procedure:
  - a. Temporarily plug all wall sleeves, piping entrances and other openings during test period.
  - b. Fill structure to overflow level.
  - c. Allow to stand for a minimum of four (4) hours.
  - d. Refill to overflow level.
  - e. Allow to stand for 24 hours.
  - f. Examine exterior surfaces and joints for leakage. Measure drop in surface water. Allowable leakage is a drop of ½ inch or less during the test period and no visible signs of leakage.
  - g. Repair all visible and detectable leaks. If leakage exceeds allowable limit, the structure shall be repaired by approved method per Engineer.

C. Equipment Acceptance: Contractor shall adjust, repair, modify, or replace components failing to perform as specified and rerun tests at no cost to the Owner.

### 3.5 ADJUSTING

A. Section 01 70 00 – Execution and Closeout Requirements.

- B. Vertical Adjustment of Existing Manholes and Structures:
  - 1. As specified in Section 33 01 30.86 – Manhole Rim Adjustment.

END OF SECTION





## SECTION 33 14 13

### WATER DISTRIBUTION PIPING, VALVES, HYDRANTS, AND APPURTENANCES

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. Section Includes Installation of:
1. Pipe and fittings for public water mains and service connections.
  2. Valves, fire hydrants, blow offs, sampling stations, air release assemblies, and other water distributions appurtenances.
- B. Related Requirements:
1. CFPUA Material Specification Manual (MSM).
  2. Section 03 05 00, Concrete.
  3. Section 09 91 00, Painting and Protective Coatings.
  4. Section 31 23 34, Excavating, Trenching, Dewatering and Backfilling.
  5. Section 33 01 12, Identification for Utilities Piping.
  6. Section 33 05 05.31, Hydrostatic Testing.
  7. Section 33 05 09.33, Thrust Restraint for Utility Piping.
  8. Section 33 05 13, Precast Concrete Manholes and Utility Structures.
  9. Section 33 14 14, Public Water Service Connections.
  10. Section 33 14 20, Disinfection of Water Pipelines, Facilities and Appurtenances.

##### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T 180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society of Mechanical Engineers:
1. ASME B16.1 – Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASTM International:
1. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  2. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
  3. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>).
  4. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  5. ASTM D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  6. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
  7. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

8. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
9. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

D. American Water Works Association:

1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C116 – Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray Iron Fittings.
7. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast.
8. AWWA C153 – Ductile-Iron Compact Fittings.
9. AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.
10. AWWA C502 – Dry-Barrel Fire Hydrants.
11. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
12. AWWA C512 – Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service.
13. AWWA C550 – Protective Interior Coatings for Valves and Hydrants.
14. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
15. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
16. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution.
17. AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
18. AWWA C906 – Polyethylene Pressure Pipe and Fittings, 4-In. Through 65-In. for Waterworks.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 – Connecting Flange Joints between Tapping Sleeves and Tapping Valves.

F. National Fire Protection Association:

1. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
2. NFPA 291 – Recommended Practice for Fire Flow Testing and Marking of Hydrants.

G. NSF International:

1. NSF 61 – Drinking Water System Components - Health Effects.
2. NSF 372 – Drinking Water System Components - Lead Content.

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Section 01 30 00, Administrative Requirements

- B. Coordination:
1. Coordinate Work of this Section with termination of water main connection at Site boundary, connection to CFPUA, and trenching.
  2. The existing system must be kept in operation at all times. Where connections are made to existing mains or other shutdowns are necessary, permission must be obtained and arrangements must be made with the CFPUA Distribution ORC, Utility Services Division for removing from service those mains that will be affected.
  3. No valves are to be operated unless a CFPUA representative is present. Any valves operated without a CFPUA representative present or a directive may be subject of penalties in accordance with CFPUA's ordinance.
  4. Notify CFPUA no less than two business days prior to an event requiring a CFPUA representative to be present.
  5. The Contractor shall, at least two business days in advance, notify citizens subject to interruption of service by means of door hangers or any other approved method of the starting time and duration of such interruption.

#### 1.4 SUBMITTALS

- A. Section 01 33 00, Submittals: Requirements for submittals.
- B. Product Data/Source Quality:
1. Manufacturer information regarding pipe, pipe fittings, valves, hydrants and appurtenances including component material, assembly and parts diagrams.
  2. Shop test results and inspection data, certified by manufacturer.
- C. Testing Procedures:
1. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER and CFPUA approval prior to commencing testing.
- D. Manufacturer Instructions:
1. Detailed instructions on installation requirements, including storage and handling procedures.
- E. Manufacturer's Certificate:
1. Certify that products meet or exceed specified requirements.
- F. Field Quality-Control Submittals:
1. Results of Contractor-furnished laboratory testing and field test results.

#### 1.5 CLOSEOUT SUBMITTALS:

- A. Section 01 70 00, Execution and Closeout Requirements.
- B. Project Record Documents:
1. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work.
  2. Record actual locations of piping mains, valves, hydrants, connections, thrust restraints, elevations, and other utilities found and not indicated on design plans.

- C. Operations and Maintenance Data:
  - 1. Furnish in operations and maintenance manuals complete data for materials in accordance with Section 01 60 00, Product Requirements.

## 1.6 QUALITY ASSURANCE

- A. Qualifications: Company specializing in manufacturing products specified in the CFPUA Materials Specification Manual.
  - 1. Cast manufacturer's name, pressure rating, and year of fabrication into valve body.
- B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- C. Perform Work according to AWWA and PVC Pipe Association standards.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00, Product Requirements.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Block individual and stockpiled pipe lengths to prevent moving.
  - 3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
  - 4. Store PE and PVC materials out of sunlight.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.8 SITE CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## 1.9 WARRANTY

- A. Section 01 70 00, Execution and Closeout Requirements.
- B. Furnish 10-year manufacturer's warranty for valves.

## PART 2 PRODUCTS

### 2.1 CFPUA MATERIAL SPECIFICATION MANUAL

- A. Refer to CFPUA Material Specification Manual (MSM) for the following products:

<b>MSM Section</b>	<b>Material</b>
A	Pipe
B	Fittings and Accessories
C	Joint Restraints
D	Valves and Accessories
E	Fire Hydrants
F	Service Saddles and Tapping Devices
I	Castings & Aluminum Access Covers
K	Miscellaneous
L	Electrical
M	Coatings and Sealants

## 2.2 MATERIALS & ACCESSORIES

- A. Bedding, Cover, and Backfill:
1. As specified in Section 31 23 34, Excavating, Trenching, Dewatering and Backfilling.
- B. Pipe Location Wire: As specified in Section 33 01 12, Identification for Utilities Piping.
- C. Thrust Restraints: As specified in Section 33 05 09.33, Thrust Restraint for Utility Piping.
- D. Service Connections: As specified in Section 33 14 14, Public Water Service Connections.
- E. Vaults and Utility Boxes: As specified in Section 33 05 13, Precast Concrete Manholes and Utility Structures.
- F. Fire Hydrant Drainage Gravel: Provide #57 Stone.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00, Execution and Closeout Requirements.
- B. Identify project horizontal and vertical control points, establish easement and right-of-way lines, stakeout construction points for work and pipeline alignments, establish limits of disturbance.
- C. Determine exact location and size of water mains, valves, hydrants, and appurtenances from Drawings
- D. Verify location and elevation of existing facilities prior to excavation and installation of proposed interconnecting water mains, valves, and hydrants.

### 3.2 PREPARATION

- A. Section 01 35 00, Special Procedures.
  - 1. Pre-construction Site Audio/Video Inspections and Photography:
  - 2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
- B. Section 01 70 00, Execution and Closeout Requirements.
- C. All materials, unless otherwise directed, shall be unloaded as nearby as possible to the location of installation by the Contractor. Materials shall be handled with care to avoid damage.
- D. All materials found during the progress of work to have flaws, cracks, or other defects will be rejected by the Engineer regardless of whether or not it has been installed and shall be replaced by and at the expense of the Contractor.
- E. All PVC pressure pipe, upon delivery to the site and until such time as it is placed in the trench, shall be shielded from the weather and direct sunlight to prevent pipe deterioration.
- F. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surfaces, interior linings and components. If any part of the coating, lining or components is damaged, the repairs or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Engineer prior to attempting installation.
- G. Pipe Cutting:
  - 1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
  - 2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
  - 3. Grind edges smooth with beveled end for push-on connections.
- H. Remove scale and dirt on inside and outside before assembly.
- I. Prepare pipe connections to equipment with flanges or unions.

### 3.3 INSTALLATION

- A. Placement: As specified in Section 31 23 34, Trenching, Excavation, Dewatering and Backfilling.
  - 1. All mains shall be laid and maintained at the required lines and grades with fittings, valves and appurtenances at the described locations. All pipe shall be laid to the depth as shown on the drawings, or when a depth is not indicated, with a minimum cover of thirty-six (36) inches and a maximum of (60) inches below finished grade. Grade lines shall be set by the Contractor. Realignment must be approved by the Engineer. The Contractor shall have suitable survey equipment on the site at all times.

2. After placement in the trench the spigot end of the pipe shall be centered in the bell and the pipe shall be driven home and then brought to the proper line and grade by tamping approved backfill material under it, except for the bell. Joint deflection shall not exceed manufacturer's limit.
3. The Work shall at all times progress with caution so as to prevent damage to underground obstructions both known and unknown. Should an obstruction not shown on the drawings be encountered, the Engineer shall be immediately notified and he shall be responsible for alteration to the design should realignment be necessary. Notify the Engineer far enough in advance to allow the realignment to be accomplished by deflection in the pipe joints.

B. Pipe and Fittings:

1. Handle and assemble pipe according to manufacturer instructions.
2. Install pipe and fittings in strict conformance with AWWA C600.
3. Install plastic pipe in conformance with ASTM D2774 and recommended practices of the UNI-BELL Plastic Pipe Association.
4. Joint Deflection: Maximum joint deflection shall meet requirements of AWWA C600 or AWWA Manual of Practice M23.
5. Prevent foreign material from entering pipe during placement. Seal pipe openings with watertight plugs during Work stoppages using plugs designed for that purpose. If trench contains standing water in joining zone, plug shall remain in place until the trench has been pumped dry before proceeding pipe laying.
6. Allow for expansion and contraction without stressing pipe or joints.
7. Install access fittings to permit disinfection of water system performed under Section 33 14 20 – Disinfection of Water Distribution Mains.
  - a. Blowoffs shall be installed for pipe flushing, disinfection, and test sampling.
  - b. Blowoffs shall be located as follows:
    - 1) Dead ends.
    - 2) Stub-outs greater than one pipe section in length for future interconnecting mains.
    - 3) Valves closed against disinfection, flushing, and sampling.
  - c. Blowoff should be installed as follows:
    - 1) Opening pointing downward.
    - 2) Minimum 24-inches clearance between opening and ground for proper sampling.
8. Cover: Measure depth of cover from final surface grade to top of pipe barrel and record.
9. Jointing:
  - a. Fused HDPE:
    - 1) HDPE Pipe shall be joined by the butt-fusion process in accordance with pipe manufacturer's directions.
    - 2) Contractor shall provide butt-fusion technicians who are trained and certified by the HDPE pipe manufacturer to complete the project. The date of technician certification shall not exceed 12 months before commencing construction.
    - 3) Butt-fusion means the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure.

- 4) The internal and external beads resulting from the butt-fusion process shall be visible and examined for penetration 360 degrees around the pipe diameter.
  - 5) DI/HDPE Mechanical Joint Adaptors shall be ductile iron mechanical joint fittings per CFPUA Material Specification Manual and shall be joined to the HDPE pipe by a heat-fused joint on one end, and connected to a ductile iron pipe valve, or fitting with a mechanical joint on the other end.
  - 6) Solvent epoxy cementing, electro-fusion couplings and mechanical joining with bolt on wrap around clamps or mechanical joints without an adapter shall not be used for connections.
- b. Push-On Joints:
- 1) The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove dirt, grit, oil or excess coatings and other foreign matter. For ductile iron pipe, the gasket shall be flexed inward and inserted in the gasket recess of the bell socket.
  - 2) A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot ends, care will be taken to avoid contact with the ground.
  - 3) The joint shall be completed by forcing the plain end to the bottom of the socket with a forked tool or jacking device or other approved method. All pipe shall have depth mark prior to insertion. Pipe cut in the field shall be filed to resemble the spigot end of manufactured pipe.
  - 4) When deflection is required the joint shall be completed prior to setting the deflection. The deflection shall conform to applicable AWWA Standards or manufacturer's recommendation.
- c. Mechanical Joints:
- 1) The inside of the socket, the outside of the spigot end and the gland shall be thoroughly cleaned and or washed with an approved solution to remove dirt, grit, oil or excess coatings and foreign matter to improve gasket seating.
  - 2) The gland shall then be placed on the plain end of the pipe with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end of the pipe.
  - 3) The pipe shall be inserted into the socket and the gasket pressed firmly and evenly into the gasket recess. The joint shall be kept straight during the assembly and any deflection required shall be done after the joint has been assembled but prior to tightening the bolts.
- C. Valves:
1. Valves shall be set and joined to the pipe and each type of joint as specified for pipe.
  2. Cast iron valve boxes shall be firmly supported, maintained centered and plumb over the operating nut of the valve. Outside of paved areas, valve boxes shall be set in a 2' diameter x 6" thick concrete collar. The box cover shall be flush with the surface of the finished pavement. All water main valve box lids shall have the word "WATER" cast in the lid.
  3. All reasonable effort must be made to locate valves/valve boxes, back of curb, in grass areas and at street corners, whenever possible.
  4. Valve boxes in areas that will require sod at a later date must be left one to two inches above existing grade (to allow for sod thickness).



5. All valves must be centered over the operating nut/wheel and all valves, after being fully opened, will be backed off one-quarter turn to prevent them from being jammed open. This procedure should take place only after the main has passed pressure testing and has been certified by the Engineer.
  6. Should the operating nut be more than three feet below the final grade, an extension shall be supplied and installed by the Contractor. The extension shall bring the nut to within twelve (12) inches of final grade.
- D. Installing Valves on Existing Mains
1. When installing valves in existing mains (cutting-in), the Contractor shall insure that the pipe is kept clean at all times and no debris, ground water, mud, oil, etc., will make their way into the pipe.
- E. Installation of Tapping Sleeves and Valves
1. Install the tapping sleeve and valve and pressure test prior to making the tap.
  2. If leaks are present, the Contractor shall repair them to the satisfaction of the Engineer or Resident Project Representative.
  3. Complete the tapping operation and close tapping valve.
  4. Tapping valve shall not be opened until new main has been tested and certified for operation.
- F. Hydrants
1. Each hydrant shall be connected to the main with a 6-inch branch line.
  2. Hydrants shall be set with the pumper nozzle facing the roadway and with the center of the lowest outlet not less than 18 inches above the finished surrounding grade and the operating nut not more than 48 inches above the finished surrounding grade.
  3. Set fire hydrants with safety flange not more than 6 inches and not less than 2 inches above grade.
  4. The hydrant shall be set in a bed of # 57 stone which shall surround the barrel at least 12 inches in all directions.
  5. Hydrants and tees (runs and branches) shall be restrained using field-applied restraint system per CFPUA MSM.
  6. Provide support blocking and drainage gravel while installing fire hydrants; do not block drain hole.
  7. After main-line pressure testing, flush fire hydrants and check for proper drainage.
- G. Thrust Restraints: As specified in Section 33 05 09.33, Thrust Restraint for Utility Piping.
1. New main construction shall be restrained by means of field or factory applied systems as shown on the Engineer drawings.
  2. Thrust blocks in new mains is prohibited except when directed by the Engineer.
  3. Where a fitting or device is to be inserted into an existing main, thrust blocking shall be installed as directed by the Engineer or CFPUA.
- H. Polyethylene (PE) encasement when indicated for ductile iron pipe and fittings:
1. Encase piping in PE as indicated on Drawings to prevent contact with surrounding soil material or insulation from adjacent cathodic protection system.
  2. Comply with AWWA C105.
  3. Where pipe exits ground, terminate encasement 3 to 6 inches above surface.

- I. Pipe Locator Wire: Install per Section 33 01 12, Identification for Utilities Piping.
- J. Service Connections: As specified in Section 33 14 14, Public Water Service Connections.
- K. Disinfection of Potable Water Piping Systems: As specified in Section 33 14 20, Disinfection of Water Distribution Mains.
- L. Pipe Markers: According to CFPUA Details and Material Specification Manual.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00, Execution and Closeout Requirements.
- B. Section 33 05 05.31, Hydrostatic Testing.
  - 1. Pressure test piping system according to AWWA C600.
- C. Section 33 14 20, Disinfection of Water Pipelines, Facilities, and Appurtenances.
- D. Pigging – Flushing and Cleaning Alternative for Large Mains
  - 1. For mains where flowrates cannot be achieved to create minimum cleaning velocities of 2 feet per second or greater, cleaning of the new piping system by pigging methods shall be established for the project by the Engineer. Pigging includes the following measures:
    - a. Pig launching and retrieval equipment to minimize additional valves, fittings and auxiliary water supplies.
    - b. Valves and blowoff assemblies, which are installed as part of the project, shall be used as much as possible to minimize the number of temporary ports required for pigging.
    - c. Pig materials used shall be specifically manufactured for flushing and cleaning pressure pipes, bends and valves. The pigs shall be able to go through bends, open valves and fittings, and provide adequate cleaning of the pipe.
    - d. Pigging shall be accomplished by the controlled and pressurized passage of a series of hydraulic or pneumatic polyurethane plugs of varying dimensions, coatings, and densities.
    - e. Pigs shall be selected by the Contractor and approved by the Engineer.
    - f. The Contractor shall provide means to enter the pig into the system, control and regulate flow, monitor flows and pressures, and to remove the pig from the system.
    - g. The Contractor shall maintain constant surveillance of the pig while active in the pipe system and immediately report problems encountered or any malfunctions discovered in the piping system.

END OF SECTION

## SECTION 33 14 14

### PUBLIC WATER SERVICE CONNECTIONS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Pipe and fittings for water service connections to small commercial, light industrial, and residential homes 2" service and smaller.
  2. Corporation stop assemblies.
  3. Curb stop assemblies.
  4. Backflow preventers.
  5. Meter setting equipment.
  6. Meter boxes.
  7. Trenching, bedding, and cover.
- B. Related Requirements:
1. CFPUA Material Specification Manual (MSM).
  2. Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.
  3. Section 33 14 13 – Water Distribution Piping and Appurtenances.
  4. Section 33 14 13 – Water Distribution Valves and Fire Hydrants.
  5. Section 33 14 20 – Disinfection of Water Distribution Mains.
  6. Section 33 05 13 – Precast Concrete Manholes and Utility Structures.
- C. CFPUA provides potable water service which may be interrupted for repairs, system expansion, or other general requirements. CFPUA does not guarantee adequate fire flow for protection of life or property. There shall be no domestic use taps allowed on a dedicated fire line. Some facility owners choose to utilize this interruptible potable water supply from the CFPUA system for fire protection. If facility owners choose to utilize the potable water system for fire protection flow, the service for fire protection shall be configured according to Part 3 of this Section.

##### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society of Mechanical Engineers:
1. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
  2. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. American Society of Sanitary Engineering:
1. ASSE 1012 – Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.

2. ASSE 1013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.

D. ASTM International:

1. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings.
2. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
3. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>).
4. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.
5. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
6. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

E. American Welding Society:

1. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.

F. American Water Works Association:

1. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
2. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
3. AWWA C800 – Underground Service Line Valves and Fittings.
4. AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
5. AWWA M6 – Water Meters – Selection, Installation, Testing, and Maintenance.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Any event requiring a CFPUA representative to be present shall require a minimum of 2 business day notice to schedule the event.
- B. No valves are to be operated unless a CFPUA representative is present. Any valves operated without a CFPUA representative present or a directive may be subject of penalties in accordance with CFPUA's ordinance.

### 1.4 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Informational Submittals:
  1. Product Data: Submit manufacturer information regarding pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventers, and accessories.
  2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
  3. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

- C. Action Submittals:
  - 1. Test Reports: Submit all the results of the bacteriological tests to the CFPUA Engineering Inspector.
  - 2. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
  - 3. Qualifications Statement:
    - a. Submit qualifications for manufacturer.

## 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, pressure-pipe centerline elevations, and gravity-pipe invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

## 1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Perform Work according to CFPUA standards and details.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## PART 2 PRODUCTS

### 2.1 MATERIAL SPECIFICATION MANUAL

- A. Refer to CFPUA Material Specification Manual (MSM) for the following products:

MSM No.	Product
A	Polyethylene Service Tubing
F	Service Saddles/ Hinged Type for 2" PVC
F	Service Saddles/ Brass Alloy/ Stainless Steel Straps for Cast, Ductile & PVC Pipe
F	Service Saddles/ Ductile Iron/ Stainless Steel Straps for Cast, Ductile & PVC Pipe
F	Service Saddles/ Ductile Iron/ Stainless Steel Straps for HDPE Pipe
F	Service Saddles/ Hinged Type for 2" HDPE
G	Inline Valves
G	Straight Couplings (3/4" X 1")
G	Straight Couplings (1")
G	Meter Setters (5/8" X 3/4" Meter)
G	Meter Setters (1" Meter)
G	Meter Setters (1 1/2" & 2" Meter)
G	Dual Service U-Branch (5/8" X 3/4" Meter)
G	Dual Service U-Branch (1" METER)
G	Curb Stop Assemblies
J	Meter Box (5/8", 3/4", & 1") Single Service Non-Traffic Areas
J	Meter Box (5/8", 3/4", & 1") Dual Service Non-Traffic Areas
J	Meter Box (5/8", 3/4", & 1") Single Service Traffic Rated
J	Meter Box (5/8", 3/4", & 1") Dual Service Traffic Rated
J	Meter Box (1 1/2", & 2") Single Service Non-Traffic Areas
J	Meter Box (1 1/2", & 2") Single Service Traffic Rated
J	Lid Details (5/8", 3/4", & 1") Single Service Non-Traffic Areas
J	Lid Details (5/8", 3/4", & 1") Dual Service Non-Traffic Areas
J	Lid Details (5/8", 3/4", & 1") Single Service Traffic Rated
J	Lid Details (5/8", 3/4", & 1") Dual Service Traffic Rated
J	Lid Details (1 1/2" & 2") Single Service Non-Traffic Areas
J	Lid Details (1 1/2" & 2") Single Service Traffic Rated
L	Tracer Wire (Solid Copper)
L	Direct Bury Wire Splice Kit

## 2.2 CURB STOP ASSEMBLIES

- A. For 5/8" – 1" services both single and double box service provide curb stop on CTS line 12" from Inlet of meter setter.
- B. Curb stop on 2-inch service not required for 1 1/2" and 2".

## 2.3 WATER METERS SINGLE SERVICE

- A. Meter box shall be installed flush with grade. Box shall be sized and centered around the meter assembly to allow for access and future maintenance.

## 2.4 DUAL SERVICE

- A. Meter box shall be installed flush with grade. Box shall be sized and centered around the meter assembly to allow for access and future maintenance.

- B. U-branch shall be installed prior to meter setter.
- C. Meter setter shall be installed to allow 3 to 6 -inches from top of meter from bottom of lid.
- D. Meter setter shall be installed in the upright position.

## 2.5 MATERIALS

- A. Bedding: As specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.
- B. Cover: As specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.
- C. Soil Backfill from Above Pipe to Finish Grade: As specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Verify that building service connections and municipal utility water main sizes, locations, and inverts are as indicated on Shop Drawings.

### 3.2 PREPARATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- C. Remove scale and dirt from inside and outside of piping before assembly.

### 3.3 INSTALLATION

- A. 1” Service Corporation Stop Assemblies:
  - 1. Make connection for each different kind of water main, using suitable materials, equipment, and methods as approved by Engineer.
  - 2. Provide service clamps for mains constructed of materials other than cast iron or ductile iron.
  - 3. Location:
    - a. Locate and stagger corporation stops at least 36 inches apart longitudinally.
  - 4. Plastic Pipe Mains:
    - a. Provide full support for service clamp for full circumference of pipe, with minimum 2-inch width of bearing area.

- b. Exercise care against crushing or causing other damage to mains at time of tapping or installation of service clamp or corporation stop.
  - 5. Use seals or other devices such that no leaks are present in mains at points of tapping.
  - 6. Do not backfill and cover service connections until installation has been approved by Engineer and CFPUA inspector.
- B. Bedding:
  - 1. Excavate pipe trench as specified in Section 31 23 34 – Excavating, Trenching, Dewatering, and Backfilling.
  - 2. Placement:
    - a. Place bedding material as indicated on Drawings.
    - b. Level fill materials in one continuous layer not exceeding 8 inches of compacted depth.
    - c. Compact to 95 percent maximum density.
  - 3. Place fill materials as specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.
- C. Pipe and Fittings:
  - 1. Maintain separation of water main from **sewer piping** according to code.
  - 2. Group piping with other Site piping Work whenever practical.
  - 3. Install pipe to allow for expansion and contraction without stressing pipe or joints.
  - 4. Install access fittings to permit disinfection of water system.
  - 5. Jointing of Pipe:
    - a. Connections between different types of pipe and accessories shall be made with transition fittings approved by CFPUA's representative.
    - b. Service laterals shall consist of a tapping saddle, corporation stop and a length of PE pipe with no joint installed between the main service tap and the service stop. Service laterals shall be installed perpendicular to the water main. Contractor shall install all material per the CFPUA Material Specification Manual allowing for meter installation at a later date by CFPUA personnel. Locator wire shall be installed as per specifications.
  - 6. Thrust Restraints: Form and place concrete for thrust restraints at each elbow or change of direction of pipe.
  - 7. Establish elevations of buried piping with not less than 3 feet of cover.
  - 8. Pipe Markers: According to CFPUA MSM.
  - 9. Backfill trench as specified in Section 31 23 34 – Excavation, Trenching, Dewatering and Backfill for Pipes.
- D. Curb Stop Assemblies:
  - 1. Set curb stops on 95% compacted soil.
- E. Water Meters: 2" and smaller shall be set by CFPUA.
- F. Backflow Preventers:
  - 1. Install backflow preventers where indicated on Drawings and according to manufacturer instructions.
  - 2. Testing and Installation Requirements: Comply with CFPUA requirements and plumbing codes, see CFPUA's website under Departments, Environmental Management – Backflow and Cross Connections.



- G. Service Connections:
  - 1. Install water service according to as indicated on Drawings.
  - 2. Install water service to 18" of right-of-way and connect to building water service as specified in CFPUA details and referenced in CFPUA Material Specification Manual.
  - 3. All meters installed on lines greater than 2-inch diameter must have a strainer and be installed in an appropriately sized, approved meter vault that provides sufficient access for reading, maintenance, and protection in accordance with Water Meter Vaults specification.
  
- H. Service Intended for Fire Protection:
  - 1. Two taps shall be installed, one for potable water and one for fire flow. The potable water tap shall be installed and metered in accordance with this Section. The fire flow tap shall not be metered and the fire flow system shall be fully segregated from the potable system throughout the facility. A valve will be installed at the tap and the right-of-way or easement line denoting the CFPUA owned/private owned boundary. A privately owned, privately maintained back-flow prevention device shall be installed in the line immediately after entering a structure in accordance with the North Carolina State Building Code and the CFPUA Cross Connection Control Ordinance.
  
- I. Pipe Locator Wire: As specified in Section 33 01 12 – Identification for Utilities Piping.
  
- J. Disinfection of Water Piping System: Flush and disinfect system as specified in Section 33 14 20 – Disinfection of Water Distribution Mains.

### 3.4 TOLERANCES

- A. Install pipe to indicated elevation to within tolerance of 1 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements.
  
- B. Pressure test water distribution system according to Section 33 05 05.31– Hydrostatic Testing of Water Distribution and Sanitary Sewer Force Mains.
  
- C. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION



## SECTION 33 14 20

### DISINFECTION OF WATER PIPELINES, FACILITIES AND APPURTENANCES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Essential procedures for disinfecting new and repaired water mains. All new water mains, services, and appurtenances shall be disinfected before they are placed in service. All water mains taken out of service for inspection, repair, or other activities shall be disinfected before they are returned to service.
  - 2. Testing and reporting of results.
- B. Each unit of constructed water main, services, and appurtenances shall be disinfected with chlorine upon successful completion of the hydrostatic test. The disinfection procedure shall be performed in strict conformance with Cape Fear Public Utility Authority (CFPUA) procedures for disinfecting water mains, as outlined in paragraphs 3.2 and 3.3 of this Section.
- C. Related Requirements:
  - 1. CFPWA Material Specification Manual (MSM).
  - 2. Section 33 14 13 – Water Distribution Piping, Valves, Hydrants and Appurtenances.
  - 3. Section 33 14 14 – Public Water Service Connections.

##### 1.2 REFERENCE STANDARDS

- A. American Water Works Association:
  - 1. AWWA B300 – Hypochlorites.
  - 2. AWWA C651 – Disinfecting Water Mains.
  - 3. AWWA M12 – Simplified Procedures for Water Examination.
  - 4. APHA, AWWA, WEF – Standard Methods for the Examination of Water and Wastewater.
- B. North Carolina Public Water Supply:
  - 1. NCPWS Rules Governing Public Water Systems Section .1000 – Disinfection of Water Supply Systems.

##### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Any event requiring a CFPWA representative to be present will require a two-business day notice to schedule the event.
- B. No valves are to be operated unless a CFPWA representative is present. Any valves operated without a CFPWA representative present or a directive may be subject to penalties in accordance with CFPWA's Ordinance.

- C. The Contractor shall pay particular attention to the scheduling requirements outlined in the procedures. The Contractor shall be responsible for furnishing and installing all required chlorine injection and monitoring ports at no additional cost to CFPUA.
- D. The mains will in no case be accepted by CFPUA for public use until the CFPUA Engineer approves the mains as having been properly disinfected.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Submittals:
  - 1. Product Data: Submit manufacturer information for proposed chemicals and treatment doses.
  - 2. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
  - 3. Disinfection Procedure: Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.
  - 4. Certify that final water complies with disinfectant quality standards of CFPUA.
  - 5. Test and Evaluation Reports: Indicate testing results comparative to specified requirements. All lab reports shall be from certified lab and submitted to CFPUA representative.
  - 6. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Disinfection Report:
  - 1. Type and form of disinfectant used.
  - 2. Date and time of disinfectant injection start and completion.
  - 3. Test locations.
  - 4. Name of person collecting samples.
  - 5. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
  - 6. Date and time of flushing start and completion.
  - 7. Disinfectant residual after flushing in ppm for each outlet tested.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to AWWA C651.
- B. QUALIFICATIONS
  - 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
  - 2. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience.

## PART 2 PRODUCTS

### 2.1 DISINFECTION CHEMICALS

- A. Chemicals:
1. Calcium hypochlorite: Comply with AWWA B300.
  2. Sodium hypochlorite: Comply with AWWA B300.

### 2.2 CHLORINE RESIDUAL TEST KITS

1. Test kits shall use methodology conforming with *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12.
2. Manufacturers:
  - a. Hach Company.
  - b. LaMotte.
  - c. Fisher Scientific.
  - d. Hellige.
  - e. Or equal.

## PART 3 EXECUTION

### 3.1 PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION

Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is, therefore, essential that the procedures of this section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination. Also, any connection of a new water main to the active distribution system prior to receipt of satisfactory samples may constitute a cross-connection. Therefore, the new main must be isolated until all bacteriological and other tests are satisfactorily completed.

- A. **KEEPING PIPE CLEAN AND DRY:** Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material. All openings in the pipeline shall be closed with watertight plugs when work is stopped at the end of the day or for other reasons.
- B. **JOINTS:** Joints of all pipes in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.
- C. **PACKING MATERIAL:** All packing material shall consist of molded or tubular rubber rings, or other approved material. Lead or asbestos material in any form shall not be permitted.
- D. **SEALING MATERIALS:** No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing or lubricating joints. Sealing and lubricating material or gaskets shall be handled in a manner that avoids

contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in closed containers and shall be kept clean. Soil conditions could warrant the upgrade of gasket material to a volatile resistant material.

- E. **CLEANING OF PIPE AND APPURTENANCES:** If dirt enters the pipe, it shall be removed and the interior pipe surface cleaned. If, in the opinion of the CFPUA representative, the dirt remaining in the pipe will not be removed by the flushing operation, then the interior shall be cleaned by mechanical means such as a hydraulically propelled foam pig or other suitable device. The cleaning method used shall not force mud or debris into the interior pipe joint spaces and shall be acceptable to CFPUA.
- F. **FLOODING BY STORM OR ACCIDENT DURING CONSTRUCTION:** If the main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section of pipeline shall be flushed until water from the pipe runs clear.

### 3.2 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Chlorination Planning:
  - 1. Before calling the CFPUA office for a time to be set up for disinfection, all of the following shall be installed or supplied by the Contractor at no cost to CFPUA. This list shall be checked and/or assembled before the CFPUA Engineering personnel arrive.
    - a. A valve may be required to be installed in the line to be disinfected near the CFPUA water main connection.
    - b. A blowoff of a brass or approved material faucet may be required to be installed at the dead end of the line, at all closed valves, and every 1,200 feet to be disinfected for flushing purposes and bacteria sampling. The opening to this blowoff should point downward, and there should be at least twenty-four inches clearance between the opening and the ground for proper sampling.
    - c. Mains connecting other mains with open valves within the system to be disinfected may cause “short circuits” resulting in improper disinfection. Valves on these connecting mains shall be checked to see if they should be closed to eliminate this problem. Blowoffs should be at both sides of valves closed to prevent “short circuits”.
    - d. Successful hydrostatic testing and CFPUA acceptance of said testing of the line is required before disinfection procedures.
    - e. A clean container shall be used to mix and/or dissolve the hypochlorite.
    - f. A clean, new wooden mixer shall be present for mixing and dissolving the hypochlorite.
    - g. A pump for pumping the chlorine solution into the line shall be present. This pump shall be gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump; for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pres-

- tures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.
- h. All temporary blowoffs and injection points shall be properly abandoned and physically disconnected when directed by CFPUA prior to the line being placed into service.
- C. Verify that access fittings have been installed under Section 33 14 13 – Water Distribution Piping and Appurtenances.
  - D. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

### 3.3 DISINFECTION PROCEDURE FOR NEW WATER MAINS AND FIRELINES

- A. Provide required equipment to perform Work of this Section.
- B. Method of Chlorination:
  - 1. Use the continuous feed method for disinfection of all new water mains. This method must give a minimum of 10 mg/L of chlorine residual at the end of the 24-hr period.
    - a. Continuous-Feed Method: The continuous-feed method is the process in which a concentrated solution of chlorine is injected into the water main. Caution shall be observed during the handling and injection of the chlorine solution as chlorine in any form is very toxic and any error could be harmful to the employees and to the public.
    - b. Preliminary Flushing: Before chlorine solutions are injected, the main shall be filled with potable water to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 3.0 ft/sec (preferably 3.5 ft/sec) unless the CFPUA representative determines that conditions do not permit the required flow or that the flow will cause undue problems when discharged to waste. An acceptable flushing velocity shall then be determined and used.
    - c. Procedure for Chlorinating the Main:
      - 1) Water supplied from the existing distribution system or other Approved public water supply shall be made to flow at a constant, measured rate into the newly installed water main. In the absence of a meter, the rate may be approximated by Approved method.
      - 2) At a point, not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 50 mg/L and not greater than 100 mg/L free chlorine residual. To ensure that this concentration is provided, measure the chlorine concentration at regular intervals of distance and time in accordance with the procedures described in the current edition of *Standard Methods for the Examination of Water and Wastewater* or AWWA Manual M12, or by using Approved chlorine test kits.
      - 3) During the application of the chlorine, valves shall be adjusted by or under the supervision of the CFPUA representative to prevent the chlorine solution from entering the existing water system. The chlorine injection

shall not cease until the entire water main is filled with a chlorine concentration of not less than 50 mg/L. All appurtenances and valves shall be operated to ensure that the chlorine solution has contact with them. The chlorinated water shall be allowed to remain for a period of not less than 24-hours.

- 4) At the end of the 24-hour period, the chlorine residual shall be measured and shall not be less than 10 mg/L in any samples collected along the water main and at the end of said water main.

C. Final Flushing:

1. Clearing the Main of Highly Chlorinated Water: Highly chlorinated water shall not remain in prolonged contact with pipe. At the end of the 24-hour contact period, the water shall be removed in order to prevent damage to the pipe lining or corrosion damage to the pipe itself. The highly-chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system.
2. Disposing of Highly Chlorinated Water: A neutralizing chemical shall be applied to the chlorinated water to be discharged to neutralize thoroughly the chlorine residual. Chlorine residual of water being disposed shall be neutralized by treating with one of the chemicals listed below:
  - a. Ascorbic Acid
  - b. Sodium Ascorbate
  - c. Sulfur Dioxide
  - d. Sodium Bisulfate
  - e. Sodium Sulfite
  - f. Sodium Thiosulfate

D. Bacteriological and Other Tests:

1. Standard Conditions: After final flushing and before the new main is opened to the distribution system, two consecutive sets of acceptable samples, taken at least 24-hours apart, shall be collected from the new main. Samples shall be collected from every 1,200-ft of new water main, from the end of the water line, and from each branch. All samples shall be tested in accordance with *Standard Methods for the Examination of Water and Wastewater*. All samples shall show the absence of coliform organisms, and a free chlorine residual equal to the level present in the existing system and shall have no visible color or particulate matter. **Must be submitted in the form of an official report by a certified lab.**
2. Special Conditions: If in the opinion of CFPWA, excess contamination has been allowed to enter the water main during construction or other events, bacteriological samples shall be taken at intervals of approximately 400 to 500 ft and shall be identified by location. Samples shall be taken of water that has stood in the new main for at least 16 hours after final flushing has been completed.
3. Sampling Procedures: Sample collection shall be in accordance with *Standard Methods for the Examination of Water and Wastewater*. A copper or PVC assembly or a combination blowoff and sampling tap may be used for mains up to 8-inches diameter. Fire hydrants may not be used for sampling purposes. After samples have been collected, analyzed, and accepted, the sampling assemblies may be removed and retained for future use. All bacteriological analysis must be completed by a N.C. certified Drinking Water laboratory. The utility contractor



shall be responsible for all costs associated with the sampling and analysis of all samples required for acceptance. **All Lab Reports shall be delivered to the CFPUA Representative before any activation can proceed.**

- E. Replace permanent system devices that were removed for disinfection.

### 3.4 DISINFECTION PROCEDURE FOR REPAIRED WATER MAINS

- A. The following procedures apply primarily when mains are wholly or partially de-watered. After the appropriate repair procedures have been completed, the existing main may be returned to service prior to completion of the bacteriological testing to minimize the time customers are out of water. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.
- B. The following procedure is considered as a minimum that may be used.
  1. Swabbing with Hypochlorite Solution: The interior of all pipe and fittings used in making repair (particularly couplings and tapping sleeves) shall be swabbed with a five (5) percent hypochlorite solution (300 mg/l concentration) before they are installed.
  2. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions independently is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water and particulate matter are eliminated.
  3. Slug Chlorination: When practical, in addition to the procedures above, the section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated with a high concentration of chlorine (as much as 300 mg/L), and the concentration allowed to stay in contact with the main for a minimum of 15 minutes. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable high chlorine odor. A chlorine residual of no greater than 3.0 mg/L shall be acceptable.
  4. Sampling: Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of flow is known, sample locations shall be determined. If the direction of flow is unknown, then samples shall be taken on each side of the main break. If bacteriological samples are unacceptable, the CFPUA representative shall determine corrective action. Daily sampling shall be continued until two successive daily samples are acceptable.

### 3.5 REPEAT DISINFECTION OF WATER MAIN

- A. If the initial disinfection fails to produce satisfactory results as per specifications, the new main shall be reflushed, rechlorinated and resampled; CFPUA may also require further cleaning methods (i.e. pigging the line) if the disinfections fails twice. If check samples also fail to produce acceptable results, the new main shall be reflushed and rechlorinated by the continuous-feed method of chlorination until satisfactory results are obtained.

- B. High velocities in the existing system, resulting from flushing the new main may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to also sample water entering the new main.

### 3.6 CONNECTION TO EXISTING SYSTEM

- A. The NCPWS certifications, final acceptance, opening of valves and activation of the existing water system will only be allowed after satisfactory samples and chlorine levels have been produced. All sampling devices and blowoffs must be removed from the water main by the contractor prior to acceptance by CFPUA. The CFPUA Operations Department will activate the system when their procedures are completed.

### 3.7 FIELD QUALITY CONTROL

- A. Section 01 70 00 – Execution and Closeout Requirements.

END OF SECTION

SECTION 33 14 22

TESTING OF SANITARY SEWER MAINS AND MANHOLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes testing and inspection of gravity sewer main, manholes, and service laterals in accordance with NCDEQ and CFPUA requirements. Location or project specific testing requirements and procedures shall be set forth by CFPUA and Engineer in approval conditions. CCTV shall be required as a minimum. Additional Testing may be requested.
- B. Sewer mains, service laterals, and manholes shall be inspected and tested in accordance with the reference standards and following table with notes.

	CCTV Inspection	Low Pressure Air Test	Exfiltration Test	Deflection Test	Infiltration/Ex-filtration Limit	Vacuum Test
Sewer Mains	Yes	Yes (Note 1)	Yes (Note 2)	Yes (Note 3)	100 gpdim (Note 4)	
Sewer Laterals	Yes	Yes (Note 1)			100 gpdim (Note 4)	
Manholes	Yes					Yes (Note 5)

Notes:

1. When sewer main diameters are 24-inches and smaller; unless water table is 2-feet or more above the top of pipe at upstream end of main or the calculated air test pressure is greater than 9 psi.
2. When sewer main diameters are greater than 24-inches.
3. Mandrel pull test after backfill is placed and stable at grade for 30-days. As an alternative to waiting 30-days to permit stabilization of the soil-pipe system, certified test results from an independent testing firm verifying that the backfill of the trench has been compacted to a least 95% maximum density may be accepted by CFPUA.
4. 100-gallons per nominal diameter-inch-mile for section tested and under 2-feet positive head.
5. Not applicable to existing manholes modified or rehabilitated.
6. Vertical compaction testing shall be performed at two (2) feet above the pipe and be completed in 2 ft lifts.
7. Horizontal compaction testing shall be performed at the tie-in point and every 100 ft thereafter.
8. Manhole compaction testing is to be performed in 2 ft lifts.

C. Related Requirements:

1. Section 33 05 13 – Precast Concrete Manholes and Utility Structures.
2. Section 33 31 11 – Sanitary Sewer Gravity Mains.

1.2 REFERENCES

- A. NC-DEQ Minimum Design Criteria for the Permitting of Gravity Sewers.

- B. American Water Works Association:
  - 1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
  - 2. AWWA M23 – PVC Pipe – Design and Installation.
- C. ASTM International:
  - 1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
  - 2. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
  - 3. ASTM F1416 – Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air
- D. Uni-Bell PVC Pipe Association:
  - 1. UNI-B-6-98 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Acceptance of any deviation from these testing requirements is at the sole discretion of the CFPUA.
- B. All defects in the pipelines, manholes and appurtenances shall be remedied by the Contractor at no additional expense to CFPUA and will be re-inspected as outlined in this Section.

### 1.4 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Submit following items prior to start of testing:
  - 1. Testing procedures.
  - 2. List of test equipment.
  - 3. Testing sequence schedule.
  - 4. Provisions for disposal of flushing and test water.
  - 5. Test gage calibration.
  - 6. Deflection mandrel drawings and calculations.
- C. Test Results: Certified copies of test results shall be furnished to the Owner and CFPUA within 1 week.
- D. CCTV Inspection: Submit two copies of the CCTV inspection to CFPUA on hard drives. The digital media recordings, television inspection logs, and digital photographs shall be named and labeled to indicate the specific sewer segment, location, and contents.

## PART 2 PRODUCTS

### 2.1 CCTV INSPECTION EQUIPMENT

- A. The equipment used for the CCTV inspection shall be specifically designed and constructed for sanitary or pressure sewer inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera shall be a color, pan-and-tilt model. The camera shall be capable of being moved through the line in either direction at a uniform rate. A push camera system is acceptable for sewer laterals.
- B. The camera, television monitor, and other components of the video system shall be capable of producing picture quality and resolution to the satisfaction of the Engineer.
- C. Inspections shall be submitted to the Engineer or Owner in electronic (digital) NASSCO format that can be imported and exported with other NASSCO PACP certified software including POSM.

## 2.2 DEFLECTION TESTING OF PLASTIC SEWER PIPING

- 1. "Go/ No Go" mandrel.
- 2. Pull/retrieval ropes.

## 2.3 EXFILTRATION TESTING

- A. Equipment:
  - 1. Plugs.
  - 2. Pump.
  - 3. Measuring Device.

## 2.4 INFILTRATION TESTING

- A. Equipment:
  - 1. V-notch weirs.

## 2.5 LOW-PRESSURE AIR TESTING

- A. Equipment:
  - 1. Air compressor.
  - 2. Air supply line.
  - 3. Shutoff valves.
  - 4. Pressure regulator.
  - 5. Pressure relief valve.
  - 6. Stopwatch.
  - 7. Plugs.
  - 8. Pressure Gage: Calibrate to 0.1 psi.
  - 9. Clear tubing for water table measurement.

## 2.6 VACUUM TESTING

- A. Equipment:
  - 1. Vacuum pump.
  - 2. Vacuum line.
  - 3. Vacuum Tester Base:
    - a. Compression band seal.

- b. Outlet port.
- 4. Shutoff Valve.
- 5. Stopwatch.
- 6. Plugs.
- 7. Vacuum Gage: Calibrated to 0.1 in. Hg.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Verify the following:
  - 1. Piping and manholes installation methods are compatible with testing requirements.
  - 2. Testing equipment is calibrated and functioning.
  - 3. Test procedures and recording methods have been submitted and approved.

### 3.2 PREPARATION

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Plugs:
  - 1. Plug outlets, wye branches, and laterals.
  - 2. Brace plugs to resist test pressures.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements
- B. Section 01 70 00 – Execution and Closeout Requirements.
- C. CCTV Procedures:
  - 1. After the sewers are completely cleaned and water is introduced, the sewers shall be inspected by means of closed-circuit television to verify that the sewers have been thoroughly cleaned, to locate active sewer services and other connections, to document the condition, and to locate sewer defects.
  - 2. Existing flow in the sewer being inspected shall be temporarily bypassed in accordance with the Bypass Pumping Plan if satisfactory images cannot be obtained with flow on the sewer. CFPUA will determine if the images are satisfactory.
  - 3. Provide ventilation and air movement to prevent the presence of vapor or mist in the sewer.
  - 4. CCTV inspections shall be performed in accordance with PACP® standards including the specific date and time of inspection.
  - 5. The camera shall be moved through the sewer by devices that do not obstruct the camera view, or interfere with proper documentation of the sewer conditions, such as manual or power winches, TV cable, and powered rewinds.

6. When manually operated winches are used to pull the television camera through the line, two-way radios, telephones, or other suitable means of communication shall be established between the two manholes or access points to ensure adequate communications between members of the crew.
7. The camera shall be moved through the line in either direction at a moderate rate, stopping to permit proper documentation of the condition. In no case shall the television camera be pulled at a speed greater than 30-feet per minute. The camera shall be stopped at joints, defects, points of significance, tributary connections, service laterals, and other connections and shall be panned, tilted, and rotated to fully view the defects and connections. Inspections shall be documented.
8. Perform dye testing during the CCTV inspections to locate and confirm active service laterals when directed to by Engineer or CFPUA.
9. Inspections shall be performed from manhole centerline to manhole centerline or access point to access point.
10. Record accurate measurements of distances. Accuracy of the distance meter shall be checked above grade by a suitable device. The accuracy shall be within 1 percent.

D. Deflection Testing of Plastic Sewer Piping:

1. Perform vertical ring deflection testing on PVC sewer piping after backfilling has been in place for at least 30 days.
2. Allowable maximum deflection for installed plastic sewer pipe is no greater than five percent of original vertical internal diameter.
3. Perform deflection testing using "go, no go" mandrel.
4. Mandrel Diameter:
  - a. Not less than 95 percent of base or average ID of pipe.
  - b. Pipe Diameter: Comply with ASTM D2122.
5. Perform testing without mechanical pulling devices.
6. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

E. Exfiltration Testing of Pipes Larger Than 24 Inches in Diameter:

1. Perform exfiltration testing not exceeding 100 gal. for each inch of pipe diameter for each mile per day for each reach of piping undergoing testing.
2. Perform testing with minimum positive head of 2 feet.

F. Infiltration Testing:

1. Maximum Allowable Infiltration: 100 gallons per nominal inch diameter of pipe for each mile per day for the reach of piping undergoing testing.
2. Include allowances for leakage from manholes.

G. Low-Pressure Air Testing:

1. Testing shall be accomplished by plugging the line at each end with pneumatic plugs.
2. Test each reach of gravity sewer piping between manholes.
3. Low-pressure air test all connected service laterals.
4. Introduce air pressure slowly to approximately 4 psig.
5. Determine ground water elevation above spring line of piping.
6. For every foot of ground water above spring line of piping, increase starting air test pressure by 0.43 psi.
7. Do not increase pressure above 9 psig.

8. Allow pressure to stabilize for at least five minutes.
9. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
10. Do not make allowance for laterals unless a test section having more than 625 square feet of lateral surface area fails to pass the air test. Adjust the time required according to UNI-B-6-98.
11. Minimum Testing Duration in Minutes:
  - a. Shall be calculated by multiplying the nominal pipe size (inches) by 0.625.
12. Record drop in pressure during testing period.
13. If air pressure drops more than 1.0 psi during testing period, piping has failed.
14. If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
15. If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.
16. If unsatisfactory testing results are achieved, make necessary repairs and retest until result meets criteria.
17. Repair visible leaks regardless of quantity of leakage.
18. UNI-B-6-98 TABLE I – MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

Min. Pipe Dia. (in.)	Time (min: sec)	Length For Min. Time (ft)	Time For Longer Length (sec)	Time (min:sec) for Length (L) Shown					
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46

H. Vacuum Testing:

1. Repair both outside and inside of joint to ensure permanent seal.
2. Test manholes prior to backfill.
3. Test manholes with manhole frame set in place.
4. Vacuum Testing:
  - a. Comply with ASTM C1244.
  - b. Plug pipe openings; securely brace plugs and pipe.
  - c. Plug lift holes with non-shrink grout.
  - d. Inflate compression band to create seal between vacuum base and structure.
  - e. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10 in. Hg (5 psig).
  - f. Close valve.
  - g. Manhole Test Duration in Seconds:
    - 1) Manhole Diameter of 4 Feet: 60.
    - 2) Manhole Diameter of 5 Feet: 75.



- 3) Manhole Diameter of 6 Feet: 90.
  - h. Record vacuum drop during test period.
  - i. If vacuum drop is greater than 1 in. Hg during testing period, repair and retest manhole.
  - j. If vacuum drop of 1.0 in. Hg does not occur during test period, manhole is acceptable; discontinue testing.
  - k. If vacuum test fails to meet 1.0-in. Hg drop in specified time after repair, repair and retest manhole.
5. If unsatisfactory testing results are achieved, repair manhole and retest until result meets criteria.
6. Repair visible leaks regardless of quantity of leakage.

END OF SECTION



## SECTION 33 31 11

### SANITARY SEWER GRAVITY MAINS

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. Section Includes Installation of:
  - 1. Pipe and fittings for sewer gravity mains.
  - 2. Gasket materials, couplings and other gravity main appurtenances.
  
- B. Related Requirements:
  - 1. CFPUA Material Specification Manual (MSM).
  - 2. Section 01 50 00 – Bypass Pumping.
  - 3. Section 03 05 00 – Concrete.
  - 4. Section 31 23 34 – Excavation, Trenching, Dewatering and Backfilling.
  - 5. Section 33 01 12 – Identification for Utilities Piping
  - 6. Section 33 14 22 – Testing of Gravity Sewer Mains and Manholes.
  - 7. Section 33 05 13 – Precast Concrete Manholes and Utility Structures.
  - 8. Section 33 05 07.13 – Utility Horizontal Directional Drilling.
  - 9. Section 33 05 07.23 – Jacking and Boring Pipe Construction.

##### 1.2 REFERENCE STANDARDS

- A. American Water Works Association:
  - 1. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - 2. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - 3. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
  - 4. AWWA C116 – Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray Iron Fittings.
  - 5. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast.
  - 6. AWWA C153 – Ductile-Iron Compact Fittings.
  - 7. AWWA C600 – Installation of Ductile Iron Mains and Their Appurtenances.
  - 8. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
  - 9. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. for Water Transmission and Distribution.
  - 10. AWWA C906 – Polyethylene Pressure Pipe and Fittings, 4-In. Through 65-In. for Waterworks.
  
- B. ASTM International:
  - 1. ASTM D698 – 12e2 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 2. ASTM D1557 – 12e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  - 3. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

4. ASTM D2241 – Standard Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
5. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
6. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Section 01 30 00 – Administrative Requirements
- B. Coordination:
  1. Coordinate Work of this Section with connection to CFPUA and trenching.
  2. The existing system must be kept in operation at all times. Where connections are made to existing mains or other shutdowns are necessary, permission must be obtained and arrangements must be made with the CFPUA Wastewater Collections ORC, Utility Services Division for removing from service those mains that will be affected.
  3. Notify CFPUA no less than two business days prior to an event requiring a CFPUA representative to be present.
  4. The Contractor shall, at least two (2) business days in advance, notify citizens subject to interruption of service by means of door hangers or any other approved method of the starting time and duration of such interruption.
  5. Bypass pumping and hauling operations may be required to interrupt service. A bypass pumping plan shall be submitted in accordance with Section 01 50 00. Shutdowns must be held to a minimum in both number and duration.

### 1.4 SUBMITTALS

- A. Section 01 33 00 – Submittals: Requirements for submittals.
- B. Product Data/Source Quality:
  1. Manufacturer's literature and specifications, as applicable, for products specified in this Section.
  2. Shop test results and inspection data, certified by manufacturer.
- C. Testing Procedures:
  1. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER's approval prior to commencing testing.
- D. Manufacturer Instructions:
  1. Submit manufacturer's instructions for handling, storing, and installing pipes and appurtenances.
- E. Manufacturer Certificates:
  1. Certificates of compliance with referenced standards, where applicable, including those of AWWA and others required by Engineer.
- F. Field Quality Control Submittals:
  1. Results of Contractor furnished testing and inspections.

## 1.5 CLOSEOUT SUBMITTALS

- A. 01 70 00 – Execution and Closeout Requirements
- B. Project Record Documents:
  - 1. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work.
  - 2. Record actual locations and elevations of piping mains, valves, hydrants, manholes, service laterals, cleanouts, connections, thrust restraints, and other utilities found and not indicated on design plans.
- C. Operations and Maintenance Data:
  - 1. Furnish in operations and maintenance manuals complete data for materials in accordance with 01 60 00 Product Requirements.

## 1.6 QUALITY ASSURANCE

- A. Qualifications: Company specializing in manufacturing products specified in the CFPWA Materials Specification Manual.
- B. Perform Work according to AWWA and PVC Pipe Association standards.
- C. The bell ends of pipe shall face the direction of laying unless otherwise directed by the Engineer, for lines on appreciable slope, the Engineer may require that bell ends face upgrade.
- D. All stainless-steel fasteners shall be 316.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Block individual and stockpiled pipe lengths to prevent moving.
  - 3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
  - 4. Store PE and PVC materials out of sunlight.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.8 SITE CONDITIONS

- A. Field Measurements:
  1. Verify field measurements prior to fabrication.
  2. Indicate field measurements on Shop Drawings.
  3. A minimum of ten-foot utility easement must be provided along the frontage of all lots and as shown for new developments.

**1.9 WARRANTY**

- 1. Section 01 70 00 – Execution and Closeout Requirements.

**PART 2 PRODUCTS**

**2.1 CFPUA MATERIALS SPECIFICATION MANUAL**

- A. Refer to CFPUA Material Specification Manual (MSM) for the following products:

<b>MSM Section</b>	<b>Material</b>
A	Pipe
B	Fittings and Accessories
C	Joint Restraints
I	Castings & Aluminum Access Covers
K	Miscellaneous
L	Electrical
M	Coatings and Sealants
N.	Concrete

**2.2 MATERIALS & ACCESSORIES**

- A. Bedding, Cover, and Backfill:
  1. As specified in Section 31 23 34 – Excavating, Trenching, Dewatering and Backfilling.
- B. Manholes:
  1. As specified in Section 33 05 13 – Precast Concrete Manholes and Utility Structures.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Identify required lines, levels, contours, and datum locations.

- C. Determine exact location and size of water mains, valves, hydrants, and appurtenances from Drawings.
- D. Verify location and elevation of existing facilities prior to excavation and installation of proposed gravity sewer mains and services.

### 3.2 PREPARATION

- A. Section 01 35 00 – Special Procedures
  - 1. Pre-construction Site Audio/Video Inspections and Photography:
  - 2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
- B. Section 01 70 00 – Execution and Closeout Requirements.
- C. All materials, unless otherwise directed, shall be unloaded as nearby as possible to the location of installation by the Contractor. Materials shall be handled with care to avoid damage.
- D. All materials found during the progress of work to have flaws, cracks, or other defects will be rejected by the Engineer regardless of whether or not it has been installed and shall be replaced by and at the expense of the Contractor.
- E. All PVC pipe, upon delivery to the site and until such time as it is placed in the trench, shall be shielded from the weather and direct sunlight to prevent pipe deterioration.
- F. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surfaces, interior linings and components. If any part of the coating, lining or components is damaged, the repairs or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Engineer prior to attempting installation.
- G. Pipe Cutting:
  - 1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
  - 2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
  - 3. Grind edges smooth with beveled end for push-on connections.
- H. Remove scale and dirt on inside and outside before assembly.

### 3.3 INSTALLATION

- A. Placement: As specified in Section 31 23 34 – Trenching, Excavation, Dewatering and Backfilling.
  - 1. All mains shall be laid and maintained at the required lines and grades with fittings and appurtenances at the described locations. All pipe shall be laid to the depth as shown on the drawings, or when a depth is not indicated, with a minimum cover of thirty-six (36) inches unless otherwise shown or approved by engineer. Grade lines shall be set by the Contractor. Realignments must be approved by the

Engineer. The Contractor shall have suitable survey equipment on the site at all times.

2. After placement in the trench the spigot end of the pipe shall be centered in the bell and the pipe shall be driven home and then brought to the proper line and grade by tamping approved backfill material under it, except for the bell. Joint deflection shall not exceed manufacturer's limit.
3. The Work shall at all times progress with caution so as to prevent damage to underground obstructions both known and unknown. Should an obstruction not shown on the drawings be encountered, the Engineer shall be immediately notified and he shall be responsible for alteration to the design should realignment be necessary. Notify the Engineer far enough in advance to allow the realignment to be accomplished by deflection in the pipe joints.

#### B. Pipe and Fittings

1. Handle and assemble pipe according to manufacturer instructions.
2. Install pipe and fittings in strict conformance with AWWA C600.
3. Joint Deflection: Maximum joint deflection shall meet requirements of AWWA C600 or AWWA Manual of Practice M23.
4. Prevent foreign material from entering pipe during placement and Work stoppages using plugs designed for that purpose. If trench contains standing water in joining zone, plug shall remain in place until the trench has been pumped dry before proceeding pipe laying.
5. Allow for expansion and contraction without stressing pipe or joints.
6. Solvent epoxy cementing, electro-fusion couplings and mechanical joining with bolt on wrap around clamps or mechanical joints without an adapter shall not be used for connections.

#### C. Push-On Joints

1. The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove dirt, grit, oil or excess coatings and other foreign matter. For ductile iron pipe, the gasket shall be flexed inward and inserted in the gasket recess of the bell socket.
2. A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot ends, care will be taken to avoid contact with the ground.
3. The joint shall be completed by forcing the plain end to the bottom of the socket with a forked tool or jacking device or other approved method. All pipe shall have depth mark prior to insertion. Pipe cut in the field shall be filed to resemble the spigot end of manufactured pipe.
4. When deflection is required the joint shall be completed prior to setting the deflection. The deflection shall conform to applicable AWWA Standards or manufacturer's recommendation.

#### D. Mechanical Joints

1. The inside of the socket, the outside of the spigot end and the gland shall be thoroughly cleaned and or washed with an approved solution to remove dirt, grit, oil or excess coatings and foreign matter to improve gasket seating.
2. The gland shall then be placed on the plain end of the pipe with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end of the pipe.



3. The pipe shall be inserted into the socket and the gasket pressed firmly and evenly into the gasket recess. The joint shall be kept straight during the assembly and any deflection required shall be done after the joint has been assembled but prior to tightening the bolts.
- E. Polyethylene Encasement
1. Polyethylene (PE) encasement when indicated for ductile iron pipe and fittings:
  2. Encase piping in PE as indicated on Drawings to prevent contact with surrounding soil material or insulation from adjacent cathodic protection system.
  3. Comply with AWWA C105.
- F. Transition from One Type of Pipe to Another
1. Provide necessary adapters, special, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
  2. Sewer service laterals shall be connected in accordance with Cape Fear Public Utility Authority Standard Drawing Details.
  3. No flexible couplings shall be used.
- G. Pipe Restraint
1. Provide restraint on ductile iron piping systems where shown or indicated in the Contract Documents below but not limited to:
    - a. All ductile iron pipe aerial crossings and carrier pipes with any joints supported on pier or inside an encasement pipe shall require the use of a rigid joint restraint.
    - b. All ductile iron pipe carrier pipes installed with joints inside an encasement pipe must utilize rigid restrained joints.
- H. Service Connections
1. In new sewer construction, PVC service connections shall be made by means of a wye, DIP service connections shall be made by means of a wye or a tee. All joints connected to the wye unit shall remain flexible.
  2. Service pipe for all properties shall be laid to the property line and plugged, as shown on the Standard Details. All sewer services shall be installed perpendicular to the main and terminate at the Right-Of-Way line. Sewer services in Cul-De-Sacs are required to be perpendicular, or must originate in end of line manhole and terminate at Right-of-Way, no acute angles to downstream main.
  3. All services tying into ductile iron mains shall be constructed of class 50, DIP with Protecto 401 ceramic epoxy lining.
  4. Cleanouts shall be located a minimum of 6 feet from all property corners. Water meter boxes are to be a minimum of 5 feet from the property corner.
  5. In cases of extra depth where service pipe cannot be laid on a continuous grade to the property line, the Contractor shall construct risers as shown on the Plans. When pipe cannot be adequately supported on undisturbed earth, it shall be supported on a concrete cradle.
  6. Trench and backfill or bore to install lateral. Bore shall accommodate pipe without void around pipe. Bore shall be at least 5' from the edge of pavement or back of curb on either side of the roadway unless approval to the contrary is given by the engineer.
  7. Connect lateral with wye.

8. Install sewer lateral with plug and one-way clean-out. Clean-out shall consist of a ¼ bend long sweep, with the necessary vertical 4" Schedule 40 PVC/DWV pipe stack. The clean-out plug shall be installed into a cast iron box and cover.
- I. Service Reconnections
    1. Service reconnections require adapters for all joints that will not connect properly with ordinary factory joints. Approved pipe cutting methods shall be used to cut any pipe required for the connection. No mortar or collars shall be used on reconnections unless specifically approved by the Engineer.
    2. No flexible couplings shall be used.
  - J. Joining New Pipe to Old Pipe
    1. Joining PVC pipe to existing vitrified clay pipe requires an adapter approved in the Cape Fear Public Utility Authority's Materials Specification Manual for all joints that will not connect properly with ordinary factory joints. Approved pipe cutting methods must be used to cut any pipe required for the connection. No mortar or collars shall be used for such connections unless approved by the Engineer.
    2. No flexible couplings shall be used.
  - K. Joining Pipe to Manholes or Other Structures
    1. All manhole connection holes shall be core drilled with a maximum hole diameter not to exceed one and a half times the pipe diameter.
    2. Approved standard groutable PVC-to-manhole fitting approved in the Cape Fear Public Utility Authority's Materials Specification Manual, or a flexible rubber boot may also be used at the manhole connection. The connection at the manhole wall shall be flexible and water tight. Any annular space inside the manhole at the connection shall be filled with approved caulking material or joint filler.
    3. Pipe connections to existing manholes shall be made so that finished work will conform, as nearly as possible to the essential requirements for new manhole construction, as specified above. Drop connections on existing manholes shall be strengthened by use of eight #6 pins, placed around the drop elbow and tee, or inside PVC drops may be used.
    4. Provide a minimum of six (6) inches of separation between edge of manhole core holes and manhole barrel joints. Provide a minimum six (6) inches separation between edges of core holes. Coring the manhole cone section is not allowed.
  - L. Sewer Guards
    1. Sewer guards are required at all manholes. Stainless steel sewer guards are required at manholes located in traffic areas.
  - M. Pipe Markers: According to CFPUA Details and Material Specification Manual.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Section 33 14 22 – Testing of Sanitary Sewer Mains and Manholes.

END OF SECTION



**Section A: Pipe**Effective Date: 01-01-20  
Revision #: 2[A 1 PVC Pipe - Schedule 40](#)[A 2 PVC Pipe - Schedule 80](#)[A 3 Polyethylene Service Tubing](#)[A 3.1 Polyethylene 2" Potable Water Main Tubing](#)[A 3.2 High Density Polyethylene Pipe \(HDPE\)](#)[A 4 PVC Pipe \(2" SDR-21\)](#)[A 5 PVC Pipe \(AWWA C – 900\) – Potable Water \(4" thru 24"\)](#)[A 5.1 PVC Pipe \(AWWA C – 900\) – Sewer \(4" thru 24"\)](#)[A 5.2 PVC Pipe Restrained Joint Pipe & Couplings \(AWWA C – 900\) \(4" thru 16"\)](#)[A 5.3 PVC Pipe Fusible \(AWWA C-900\) - Potable Water \(4" thru 24"\)](#)[A 5.3.1 PVC Pipe Fusible \(AWWA C-900\) - Sewer Force Main \(4" thru 24"\)](#)[A 6 Ductile Iron Pipe/ Push-On Joint/ Class 350 \(4" thru 36"\)](#)[A 6.1 Ductile Iron Pipe/ Flanged Joint/ Class 53](#)[A 6.2 Ductile Iron Pipe/ Restrained Push-On Joint/ TR Flex Joint \(4" thru 36"\)](#)[A 6.3 Ductile Iron Pipe/ Restrained Push-On Joint/ Flex- Ring Joint \(4" thru 48"\)](#)[A 7 Stainless Steel Pipe](#)[A 8 Galvanized Pipe \(Temporary\)](#)

**A 1 – PVC PIPE - SCHEDULE 40:**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL / SPECIFICATION:**

Schedule 40 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D1785, dimensional requirements, minimum burst and sustained pressure requirements, maximum operating pressure, and test procedures for determining pipe quality with respect to workmanship and materials.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSF-pw”.
- ASTM D1784, manufactured from compounds with Cell Classification 12454B (Type 1, Grade 1 material).

**CONNECTIONS:**

- Plain end X plain end.
- Plain end X solvent weld bell.

**DIMENSIONS:**

- 20’ standard joint length.



**MANUFACTURER:**

- CHARLOTTE PIPE AND FOUNDRY
- COLONIAL
- DIAMOND PLASTICS
- FREEDOM PLASTICS
- NAPCO
- NATIONAL PIPE & PLASTICS
- JM EAGLE
- IPEX
- PIPELIFE

**RESTRICTIONS:**

Use of this product is limited to:

- Sewer service laterals
- 2” Water blow offs
- Water lines

**A 2 – PVC PIPE - SCHEDULE 80:**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

Schedule 80 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D1785, dimensional requirements, minimum burst and sustained pressure requirements, maximum operating pressure, and test procedures for determining pipe quality with respect to workmanship and materials.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSF-pw”.
- ASTM D1784, manufactured from compounds with Cell Classification 12454B (Type 1, Grade 1 material).

**CONNECTION:**

- Plain end X plain end
- Plain end X solvent weld bell

**DIMENSIONS:**

- 20’ standard joint length

**SIZES:**

- 3/4”
- 1”
- 1-1/2”
- 2”



**MANUFACTURER:**

- CHEMTROL
- CHARLOTTE PIPE AND FOUNDRY
- COLONIAL
- ESLON THERMOPLASTICS
- FREEDOM PLASTICS
- NATIONAL PIPE AND PLASTICS
- WORLD OF PLASTICS, INC.
- JM EAGLE
- IPEX
- NORTH AMERICAN PIPE
- PIPELIFE

**RESTRICTIONS:**

- Pump station chemical feed applications downstream from backflow preventer.

**A 3 – POLYETHYLENE SERVICE TUBING:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

PE-3608 High Density Polyethylene, HDPE, tubing shall meet or exceed the performance specifications of:

- PE-3608 Resin listed in Plastic Pipe Institute TR4 Cell classification per ASTM Standards D3350 = 345444 or 345464.
- ASTM Standards D2737 dimensional standard, Copper Tubing Size, CTS, controlled outside diameter.
- AWWA C901
- MFG. Shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements for pipe in this classification.

**POTABLE WATER REQUIREMENT:**

- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSF-pw”.

**PRESSURE RATING:**

- 200-psi. operating pressure @ 73.4 F

**COLOR-CODED:**

- Blue - potable water

**DIMENSIONS:**

- Copper tubing size, C.T.S. O.D. controlled
- DR-9

**SIZES:**

- 1”
- 2”



**MANUFACTURER:**

- DURA-LINE PW TUBING
- ADS
- CHARTER PLASTICS
- ENDOT

**RESTRICTIONS:**

Use of this product is limited to:

- Water service lines



**A 3.1 – POLYETHYLENE 2” POTABLE WATER MAIN TUBING:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

PE-3608 High Density Polyethylene, HDPE, tubing shall meet or exceed the performance specifications of:

- PE-3608 Resin listed in Plastic Pipe Institute TR4 Cell classification per ASTM Standards D3350 = 345444 or 345464E.
- ASTM Standards D3035 dimensional standard, Iron Pipe Size, IPS, controlled outside diameter.
- AWWA C901
- MFG. Shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements for pipe in this classification.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSFpw”.

**PRESSURE RATING:**

- 200-psi. operating pressure @ 73.4 F

**COLOR-CODED:**

- Blue - potable water
- Black with minimum of three (3) evenly spaced blue stripes - potable water

**DIMENSIONS:**

- Iron pipe size, I.P.S. O.D. controlled
- DR-9

**SIZES:**

- 2”



**MANUFACTURER:**

- CHARTER PLASTICS/BLUE STRIPE PIPE
- ENDOPURE/ BLUE WITH CLEAR CORE
- LAMSON VYLON/ PRESSURE FLEX WATER
- ADS

**RESTRICTIONS:**

Use of this product is limited to:

- 2” potable water mains

**A 3.2 – HIGH DENSITY POLYETHYLENE PIPE (HDPE) 4”-36”:**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

PE-4710 High Density Polyethylene, HDPE, pipe shall meet or exceed the performance specifications of:

- PE-4710 Resin listed in Plastic Pipe Institute TR4.
- Cell classification per ASTM D3350 = 345444C or 345464C for black OR 345444E or 345464E for non-black & color.
- ASTM F 714, minimum wall values.
- AWWA C906.
- MFG. Shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements for pipe in this classification.

**POTABLE WATER REQUIREMENTS:**

- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or "NSF-pw".

**COLOR– CODED:**

- Blue - potable water.
- Green - sanitary sewer/ force main.

**DIMENSIONS:**

- Ductile iron pipe size O.D., D.I.P.S.
- DR-11, DR-13.5

**PRESSURE RATING:**

- 200-psi. operating pressure @ 73.4 F for DR-11.
- 160-psi. operating pressure @ 73.4 F for DR-13.5

**JOINING RESTRICTIONS:**

- Compression type connections are not acceptable in new installations.
- Pipe joints shall be butt fusion.
- No electro fusion coupling joints will be accepted.
- Flange or mechanical joint adapters shall be used for pipe and fitting transitions.

**RESTRICTIONS:**

- DR-13.5 considered for mains 6” and larger when hydraulic or availability restrictions apply. Submittal to and approval by CFPWA required.

**FIRE MAIN PRESSURE RATING & REQUIREMENTS:**

- Dimension Ratio (DR) DR-11, pressure class 200 for fire mains.
- Factory Mutual Approved (FM) pipe.



**MANUFACTURER:**

- CHARTER PLASTICS/ STRIPE PIPE
- CP CHEMICAL
- PERFORMANCE PIPE DRISCOPEX
- FLYING W PLASTICS
- JM EAGLE PE PIPE
- LAMSON VYLON/ PRESSURE FLEX WATER
- RINKER MATERIALS– POLY PIPE
- WL PLASTICS

**A 4 – PVC Pipe (2” SDR 21):**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

2” SDR 21 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D2241 or latest revision thereof.
- ASTM D1784, manufactured from compounds with cell classification 12454B.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSF-pw”.
- Push-on integral bell type supplied with elastomeric gaskets installed.
- Joints per ASTM D3139 testing requirements.
- Gaskets per ASTM F477.
- Pipe shall be clean and ends shall be tarped during shipment.
- Standard Dimension Ratio (SDR) 21.
- No solvent-cement weld pipe or fittings will be accepted.

**PRESSURE RATING:**

- 200 psi. at 23 Degrees C (73.4 Degrees F)

**COLOR-CODED:**

- Blue - potable water

**DIMENSIONS:**

- Iron pipe size (IPS) Outside diameter controlled
- 20’ and 21’ standard joint length



**MANUFACTURER:**

- CHARLOTTE PIPE AND FOUNDRY
- DIAMOND PLASTICS
- FREEDOM PLASTICS
- JM EAGLE
- NAPCO
- NATIONAL PIPE & PLASTICS
- PIPELIFE

**RESTRICTIONS:**

Use of this product limited to:

- 2” Water Mains

**A 5 – PVC PIPE (AWWA C-900) - POTABLE WATER (4” THRU 24”):**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

AWWA C-900 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D1784, manufactured from compounds with cell classification 12454A or 12454B.
- Push-on integral bell type joints per ASTM D3139 testing requirements, supplied with elastomeric gaskets installed.
- Gaskets per ASTM F477.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSF-pw”.
- Pipe shall be clean and ends shall be tarped during shipment.
- No solvent-cement weld pipe or fittings will be accepted.
- Affidavit of compliance to this specification shall be available upon request.

**COLOR- CODED:**

- Blue - potable water

**DIMENSIONS:**

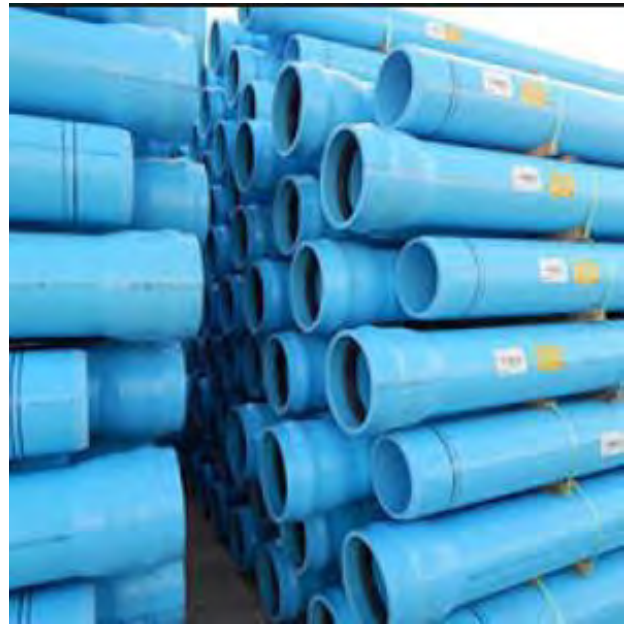
- Ductile iron pipe size O.D., D.I.P.S.
- DR-18, DR-14
- 20’ standard joint length

**PRESSURE RATING:**

- 235-psi. operating pressure @ 73 F for DR-18.
- 305-psi. operating pressure @ 73 F for DR-14.

**FIRE MAIN PRESSURE RATING & REQUIREMENTS:**

- Dimension Ratio (DR) 14, pressure class 200 for fire mains.
- Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) required on DR 14 pipe.
- No solvent-cement weld pipe or fittings will be accepted.



**MANUFACTURER:**

- DIAMOND PLASTICS
- FREEDOM PLASTICS
- JM EAGLE/ BLUE BRUTE
- NAPCO
- NATIONAL PIPE & PLASTICS
- PIPELIFE

**RESTRICTIONS:**

- DR-14 is a design option for special installations. CFPWA approval required.

**A 5.1 – PVC PIPE (AWWA C-900) - SEWER (4" THRU 24"):**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

AWWA C-900 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D1784, manufactured from compounds with cell classification 12454A or 12454B.
- Push-on integral bell type joints per ASTM D3139 testing requirements, supplied with elastomeric gaskets installed.
- Gaskets per ASTM F477
- Pigment stabilizers and ultraviolet inhibitors shall be used to prevent fading for a period of six (6) months after delivery.
- Pipe shall be clean and ends shall be tarped during shipment.
- No solvent-cement weld pipe or fittings will be accepted.
- Affidavit of compliance to this specification shall be available upon request.

**COLOR- CODED:**

- Green - sanitary sewer

**DIMENSIONS:**

- Ductile iron pipe size O.D., D.I.P.S.
- DR-18, DR-14
- 20' standard joint length
- Shorter joints acceptable for sewer only

**PRESSURE RATING:**

- 235-psi. operating pressure @ 73 F for DR-18.
- 305-psi. operating pressure @ 73 F for DR-14.

**RESTRICTIONS:**

- DR-14 is a design option for special installations. CFPUA approval required.



**MANUFACTURER:**

- DIAMOND PLASTICS
- FREEDOM PLASTICS
- JM EAGLE/ BLUE BRUTE
- NAPCO
- NATIONAL PIPE & PLASTICS
- PIPELIFE



**A 5.2 – PVC PIPE RESTRAINED JOINT PIPE & COUPLINGS (AWWA C-900)  
(4” THRU 16”):**

Effective Date: 01-01-20  
Revision #: 2

**MATERIAL / SPECIFICATION:**

AWWA C-900, Pipe shall meet or exceed the performance specifications of:

- ASTM D1784, manufactured from compounds with cell classification 12454A or 12454B.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or “NSF-pw” for all blue pipe (potable water installation).
- Joined using separate couplings that have built in sealing gaskets (O-rings) and restraining grooves.
- Shall be joined using high-strength flexible plastic splines inserted into mating precision-machine grooves, which align when the pipe is fully inserted, providing a full 3600 restraint with evenly distributed loading.
- Joints per ASTM D3139 testing requirements.
- Gaskets per ASTM F477.
- Pipe shall be clean and ends shall be tarped during shipment.
- No solvent-cement weld pipe or fittings will be accepted.
- Affidavit of compliance to this specification shall be available upon request.

**COLOR– CODED:**

- Blue– potable water
- Green– sanitary sewer/ force main

**DIMENSIONS:**

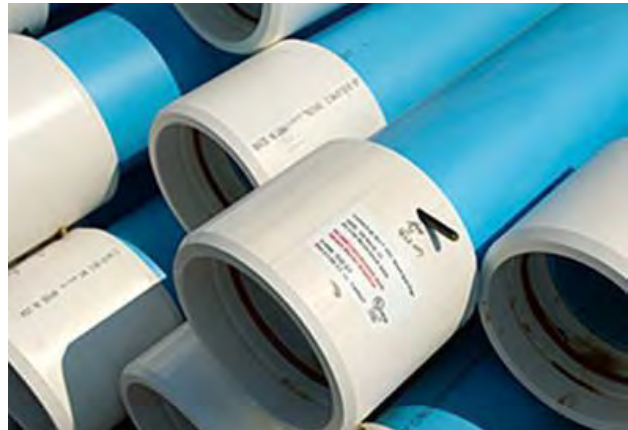
- Ductile iron pipe size O.D., D.I.P.S.
- DR-18, DR-14.
- 20’ standard joint length.

**PRESSURE RATING:**

- 235-psi. operating pressure @ 73 F for DR-18.
- 305-psi. operating pressure @ 73 F for DR-14.

**RESTRICTIONS:**

- Only for low profile carrier pipes inside casings with prior approval by CFPUA.
- DR-14 is a design option for special installations. CFPUA approval required.



**MANUFACTURER:**

- CERTAINTEED– CERTA-LOK
- JM EAGLE LOC 900
- DIAMOND LOK-21

<b>A 5.3 – PVC PIPE FUSIBLE (AWWA C-900) - POTABLE WATER (4" THRU 24"):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**MATERIAL/ SPECIFICATION:**  
Fusible AWWA C-900 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D1784, manufactured from compounds with cell classification 12454.
- Manufacture shall be listed with the Plastic Pipe Institute (PPI) as meeting the recipe and mixing requirements for pipe in this classification.
- Extruded with a unique formulation, for fusible pipe, that meets all requirements of PPI TR-2 "PPI PVC Range Composition Listing of Qualified Ingredients".
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61 or NSF-pw.
- Pipe shall be clean and ends shall be tarpred during shipment.
- Pipe shall be extruded with plain ends. The end shall be square to the pipe and free of any bevel or chamfer.
- Fusible pipe shall be joined per the manufacture's recommendation.
- Installation shall not exceed manufacture's bending radius and safe pulling force.
- No solvent-cement weld pipe or fittings will be accepted.
- Affidavit of compliance to this specification shall be available upon request.

**COLOR- CODED:**

- Blue - potable water

**DIMENSIONS:**

- Ductile iron pipe size O.D., D.I.P.S.
- DR-18 DR-14
- 20', 30' or 40' standard joint length.

**PRESSURE RATING:**

- 235-psi. operating pressure @ 73 F for DR-18.
- 305-psi. operating pressure @ 73 F for DR-14.



**MANUFACTURER:**

- UNDERGROUND SOLUTIONS

**RESTRICTIONS:**

- DR-14 is a design option for special installations. CFPWA approval required.

**A 5.3.1 – PVC PIPE FUSIBLE (AWWA C-900) - SEWER FORCE MAIN (4” THRU 24”):**

Effective Date: 01-01-20  
Revision #: 2

**MATERIAL/ SPECIFICATION:**

Fusible AWWA C-900 Polyvinyl Chloride, PVC, Pipe shall meet or exceed the performance specifications of:

- ASTM D1784, manufactured from compounds with cell classification 12454.
- Manufacture shall be listed with the Plastic Pipe Institute (PPI) as meeting the recipe and mixing requirements for pipe in this classification.
- Extruded with a unique formulation, for fusible pipe, that meets all requirements of PPI TR-2 “PPI PVC Range Composition Listing of Qualified Ingredients”.
- Pipe shall be clean and ends shall be tarped during shipment.
- Pipe shall be extruded with plain ends. The end shall be square to the pipe and free of any bevel of chamfer.
- Fusible pipe shall be joined per the manufacture’s recommendation.
- Installation shall not exceed manufacture’s bending radius and safe pulling force.
- No solvent-cement weld pipe or fittings will be accepted.
- Affidavit of compliance to this specification shall be available upon request.

**COLOR– CODED:**

- Green - sewer force main

**DIMENSIONS:**

- Ductile iron pipe size O.D., D.I.P.S.
- DR-14, DR-18
- 20’, 30’ or 40’ standard joint length.

**PRESSURE RATING:**

- 235-psi. operating pressure @ 73 F for DR-18.
- 305-psi. operating pressure @ 73 F for DR-14.

**RESTRICTIONS:**

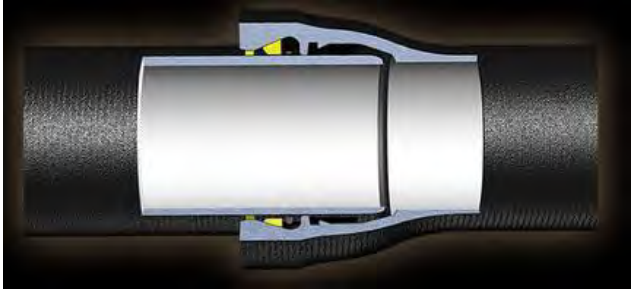
- DR-14 is a design option for special installations. CFPUA approval required.



**MANUFACTURER:**

- UNDERGROUND SOLUTIONS



<p><b>A 6 – DUCTILE IRON PIPE/ PUSH-ON JOINT/ CLASS 350 (4” THRU 36”):</b></p>		<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
<p><b><u>MATERIAL/ SPECIFICATION:</u></b></p> <ul style="list-style-type: none"> <li>• Pipe shall conform with AWWA C151 (ANSIA21.51). Additionally, pipe exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc shall be 200 g/m2 of pipe surface area. A finishing layer topcoat system shall conform to ISO 8179-1 Ductile iron pipes – External zinc based coating – Part 1: Metallic zinc with finishing layer.</li> <li>• Gaskets shall be furnished in accordance with AWWA C111 (ANSI– A21.11).</li> <li>• Pipe supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) for sizes four (4”) thru twelve (12”) inch.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>DIMENSIONS:</u></b></p> <ul style="list-style-type: none"> <li>• 18’ or 20’ standard joint length.</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• Class 350- psi. for sizes 4” thru 24” pipe.</li> <li>• Class 250- psi for sizes 30” thru 36” pipe.</li> </ul>	<p><b><u>COATING &amp; LINING:</u></b></p> <p><b>Potable Water:</b></p> <ul style="list-style-type: none"> <li>• Exterior - AWWA C151 (ANSI-A21.51), per above ISO 8179-1 requirements.</li> <li>• Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> </ul> <p><b>Sanitary Sewers and Force Mains:</b></p> <ul style="list-style-type: none"> <li>• Exterior - AWWA C151 (ANSIA21.51) per above ISO 8179-1 requirements.</li> <li>• Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment “PROTECTO 401” or “PERMOX CTF” (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres “tnemec series 431 permashield pl” (40 mils nominal).</li> <li>• The inside of the bell socket including a portion of the gasket cavity and a portion of the pipe barrel are also coated with the above products (6” mils nominal, 10 maximum).</li> </ul> 	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AMERICAN CAST IRON– FASTITE</li> <li>• McWANE, INC.– TYTON</li> <li>• US PIPE &amp; FOUNDRY– TYTON</li> </ul>	

**A 6.1 – DUCTILE IRON PIPE/ FLANGE JOINT/ MINIMUM CLASS 53:**

Effective Date: 01-01-20  
Revision #: 2

**MATERIAL/ SPECIFICATION:**

Flange pipe shall meet or exceed the performance specifications of:

- Pipe shall conform with AWWA C151 (ANSIA21.51).
- Flanges shall conform to the chemical and physical properties specified for ductile iron fittings in ANSI/AWWA C 110/A21.10.
- Shall conform to AWWA C115 (ANSI-A21.15) flange pipe and fitting joints.
- Shall be drilled and faced to conform with ANSI B16.1 Class 125 flanges.

**GASKETS SHALL BE RING OR FULL-FACE TYPE AND PRODUCED FROM ONE OF THE FOLLOWING MATERIALS:**

- EPDM (Ethylene Propylene Diene Monomer)
- Nitrile Buna-N (NBR) (Acrylonitrile Butadiene)
- Viton; Fluorel (FKM) (Fluorocarbon)
- Pipe supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- Affidavit of compliance to this specification shall be available upon request.

**DIMENSIONS:**

- Ductile iron pipe size O.D., D.I.P.S.
- 18’ or 20’ standard joint length or as specified for project.

**PRESSURE RATING:**

- Class 250-psi. for sizes 4” thru 24” pipe.

**RESTRICTIONS:**

- Flange pipe is for use in inside buildings, above ground outside, or inside underground vault or manhole service applications.

**COATING & LINING:**

**Potable Water:**

- Exterior - AWWA C151 (ANSI-A21.51), per above ISO 8179-1 requirements.
- Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.

**Sanitary Sewers and Force Mains:**

- Exterior - AWWA C151 (ANSIA21.51). per above ISO 8179-1 requirements.
- Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment “PROTECTO 401” or “PERMOX CTF” (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres “TNEMEC SERIES 431 PERMA-SHIELD PL” (40 mils nominal).



**MANUFACTURER:**

- AMERICAN CAST IRON
- McWANE, INC.
- US PIPE & FOUNDRY

**A 6.2 – DUCTILE IRON PIPE/ RESTRAINED PUSH-ON JOINT/TR FLEX JOINT (4” THRU 36”):**

Effective Date: 01-01-20  
Revision #: 2

**MATERIAL / SPECIFICATION:**

Restrained pipe shall meet or exceed the performance specifications of:

- Shall conform with AWWA C150 (ANSI–A21.50) thicknesses and strength.
- Shall conform with AWWA C151 (ANSI-A21.51), Additionally, pipe exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc shall be 200 g/m<sup>2</sup> of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The zinc coating system shall conform to ISO 8179-1 “Ductile iron pipe – External zinc based coating – Part 1: Metallic zinc with finishing layer.
- Gaskets shall be furnished in accordance with AWWA C111 (ANSI– A21.11).
- Shall use a standard size Tyton gasket.
- Shall use ductile iron locking segments, inserted through a slot (or slots) in the bell face, to provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.
- Pipe supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) for sizes four (4”) thru twelve (12”) inch.
- Affidavit of compliance to this specification shall be available upon request.

**PRESSURE RATING:**

- Class 350-psi. for sizes 4” thru 24” pipe.
- Class 250-psi. for sizes 30” thru 36” pipe.

**DIMENSIONS:**

- Ductile iron pipe size O.D., D.I.P.S.
- 18’ or 20’ standard joint length.

**RESTRICTIONS:**

**COATING & LINING:**

**Potable Water:**

- Exterior - AWWA C151 (ANSI-A21.51) per above ISO 8179- 1 requirements.
- Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.


**Sanitary Sewers and Force Mains:**

- Exterior - AWWA C151 (ANSIA21.51) per above ISO 8179-1 requirements.
- Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment “PROTECTO 401” or “PERMOX CTF” (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres “TNE MEC SERIES 431 PERMA-SHIELD PL” (40 mils nominal).



**MANUFACTURER:**

- US PIPE & FOUNDRY– TR FLEX
- McWANE, INC.– TR FLEX

<b>A 6.3 – DUCTILE IRON PIPE/ RESTRAINED PUSH-ON JOINT/FLEX- RING JOINT (4” THRU 48”):</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>MATERIAL / SPECIFICATION:</u></b> Restrained pipe shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall conform with AWWA C150 (ANSI–A21.50) thicknesses and strength.</li> <li>• Shall conform with AWWA C151 (ANSI-A21.51), Additionally, pipe exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc shall be 200 g/m<sup>2</sup> of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The zinc coating system shall conform to ISO 8179-1- Ductile iron pipe – External zinc based coating – Part 1: Metallic zinc with finishing layer.</li> <li>• Gaskets shall be furnished in accordance with AWWA C111 (ANSI-A21.11).</li> <li>• Shall use a standard size Fastite gasket.</li> <li>• Pipe supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) for sizes four (4”) thru twelve (12”) inch.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• Class 350-psi. for sizes 4” thru 24” pipe.</li> <li>• Class 250-psi. for sizes 30” thru 36” pipe.</li> </ul> <p><b><u>DIMENSIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Ductile iron pipe size O.D., D.I.P.S.</li> <li>• 18’ or 20’ standard joint length.</li> </ul> <p><b><u>ADDITIONAL INFORMATION:</u></b></p> <ul style="list-style-type: none"> <li>• Standard Flex-Ring segments are yellow.</li> <li>• Field Flex-Ring segments are black.</li> </ul>	<p><b><u>COATING &amp; LINING:</u></b> <b>Potable Water:</b></p> <ul style="list-style-type: none"> <li>• Exterior - AWWA C151 (ANSI-A21.51) per above ISO 8179-1 requirements.</li> <li>• Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> </ul> <p><b>Sanitary Sewers and Force Mains:</b></p> <ul style="list-style-type: none"> <li>• Exterior - AWWA C151 (ANSIA21.51) per above ISO 8179-1 requirements.</li> <li>• Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment “PROTECTO 401” or “PERMOX CTF” (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres “TNEMEC SERIES 431 PERMA-SHIELD PL” (40 mils nominal).</li> </ul>	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AMERICAN CAST IRON– FLEX-RING</li> </ul>	

**A 7 – STAINLESS STEEL PIPE:**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

- Schedule 40, 316 stainless steel pipe.
- Specifications shall conform to ANSI/ASME 36.19.

**CONNECTIONS:**

- Pipe shall have NPT threads on both ends and a coupling on one end making a full joint, mipt X fipt. As required on detail drawings.

**DIMENSIONS:**

- 21' standard joint length.



**MANUFACTURER:**

- OPEN

**RESTRICTIONS:**

- This material is required for air/vacuum release valve piping or other special uses as noted on detail drawings.



**A 8 – GALVANIZED PIPE (TEMPORARY):**

Effective Date: 01-01-20  
 Revision #: 2

**MATERIAL/ SPECIFICATION:**

- Schedule 40, galvanized steel pipe.
- Specifications shall conform to ASTM A-53 grade-A or latest revision thereof.

**CONNECTIONS:**

- Pipe shall have NPT threads on both ends and a coupling on one end making a full joint, mipt X fipt.

**DIMENSIONS:**

- 21' standard joint length.



**MANUFACTURER:**

- OPEN

**RESTRICTIONS:**

- This material is only used for temporary sampling and flushing points during pipeline construction.
- Galvanized pipe is not acceptable for any other use.

<b>Section B: Fittings and Accessories</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<a href="#">B 1 <u>PVC Fittings - Schedule 40</u></a>	
<a href="#">B 2 <u>PVC Fittings - Schedule 80</u></a>	
<a href="#">B 3 <u>HDPE Flange &amp; Mechanical Joint Adapters (AWWA C 906)</u></a>	
<a href="#">B 4 <u>HDPE Pipe Wall Stiffeners</u></a>	
<a href="#">B 5 <u>Plastic Fittings (SDR-21)</u></a>	
<a href="#">B 6 <u>PVC Fittings - Gasketed (AWWA C 900)</u></a>	
<a href="#">B 7 <u>Brass Fittings/Miscellaneous</u></a>	
<a href="#">B 8 <u>Flanged Joint Fittings (AWWA C 110)</u></a>	
<a href="#">B 8.1 <u>Flange Joint Accessory Kits</u></a>	
<a href="#">B 9 <u>Mechanical Joint Fittings (AWWA C 110 Full Body), (4" thru 36")</u></a>	
<a href="#">B 10 <u>Mechanical Joint Fittings (AWWA C 153 Compact Body), (4" thru 48")</u></a>	
<a href="#">B 11 <u>Mechanical Joint Accessory Kits</u></a>	
<a href="#">B 12 <u>Mechanical Joint Connector</u></a>	
<a href="#">B 13 <u>Push-on Restrained Joint Fittings (4" thru 36") TR Flex</u></a>	
<a href="#">B 14 <u>Push-on Restrained Joint Fittings (4" thru 48") Flex Ring</u></a>	
<a href="#">B 15 <u>Uni-Fit Wide Range Adapter</u></a>	

**B 1 – PVC FITTINGS – Schedule 40:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION/MATERIAL:**

Schedule 40 PVC fittings shall meet or exceed the performance specifications of:

- ASTM Standards D2466, this standard covers Schedule 40 PVC threaded and socket pressure fittings. The standard stipulates thread and socket specifications as well as minimum lengths, wall thicknesses, burst pressures, material classification, quality, and requirements for marking identification.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines, when used in a potable water installation.

**CONNECTIONS:**

- **Tees** - Solvent Weld (slip) X Solvent Weld (slip)
- **Union** - Solvent Weld (slip) X Solvent Weld (slip), Female Pipe Thread (FPT) X Female Pipe Thread (FPT)
- **Elbow** - Solvent Weld (slip) X Solvent Weld (slip)
- **Cross** - Solvent Weld (slip) X Solvent Weld (slip)
- **Couplings** - Solvent Weld (slip) X Solvent Weld (slip)
- **Riser Extender** - Male Pipe Thread (MPT) X Female Pipe Thread (FPT)
- **Adapters** - Male Pipe Thread (MPT) X Solvent weld (slip)
- **Bushing** – Spigot X Solvent Weld (slip), Spigot X Female Pipe Thread (FPT), Male Pipe Thread (MPT) X Female Pipe Thread (FPT)
- **Cap** - Solvent Weld (slip), Female Pipe Thread (FPT)
- **Plug** - Spigot, Male Pipe Thread (MPT)
- **Wye** - Solvent Weld (slip) X Solvent Weld (slip) X Solvent Weld (slip)

**RESTRICTIONS:**

- 4" and 6" sewer service laterals from main to service cleanout at right-of-way
- 2" water blow-offs

**COLOR-CODED:**

- White- all services
- Gray- all services

**SIZES:**

- 2"
- 4"
- 6"



TEE



UNION



ELBOW



CROSS



COUPLING



RISER EXTENDER



ADAPTER



BUSHING



CAP



PLUG







































WYE


**MANUFACTURER:**

- COLONIAL
- CHARLOTTE PIPE AND FOUNDRY
- IPEX
- LASCO
- SPEARS



<b>B 2 – PVC FITTINGS – Schedule 80:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>																							
<p><b><u>SPECIFICATION/MATERIAL:</u></b> Schedule 80 fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• ASTM Standards D-2467, solvent weld and pressure fittings, dimensions, thread gauging, minimum wall thickness and burst pressure, material classification, various quality aspects and requirements for marking identification for plugs.</li> <li>• ASTM Standards D-1784, manufactured from compounds with cell classification 12454B (type 1, grade 1 material) for nipples &amp; plugs.</li> <li>• ASTM Standards D-1785, dimensional requirements, minimum burst and sustained pressure requirements, maximum operating pressure, and test procedures for determining pipe quality with respect to workmanship and materials for nipples.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines.</li> </ul> <p><b><u>CONNECTION:</u></b></p> <ul style="list-style-type: none"> <li>• <b>Tees</b> - Solvent Weld (slip) X Solvent Weld (slip)</li> <li>• <b>O-Ring</b></li> <li>• <b>Elbow</b> - Solvent Weld (slip) X Solvent Weld (slip)</li> <li>• <b>Cross</b> - Solvent Weld (slip) X Solvent Weld (slip)</li> <li>• <b>Couplings</b> - Solvent Weld (slip) X Solvent Weld (slip)</li> <li>• <b>Adapters</b> - Male Pipe Thread (MPT) X Solvent weld (slip), Female Pipe Thread (FPT) X Solvent weld (slip)</li> <li>• <b>Bushing</b> – Spigot X Solvent Weld (slip), Spigot X Female Pipe Thread (FPT), Male Pipe Thread (MPT) X Female Pipe Thread (FPT)</li> <li>• <b>Cap</b> - Solvent Weld (slip), Female Pipe Thread (FPT)</li> <li>• <b>Plug</b> - Spigot, Male Pipe Thread (MPT)</li> <li>• <b>Flange</b> - Solid Style, Blind, Loose Ring</li> <li>• <b>Wye</b> - Solvent Weld (slip) X Solvent Weld (slip) X Solvent Weld (slip)</li> <li>• <b>Union</b> - Solvent Weld (slip) X Male Pipe Thread (MPT), Solvent Weld (slip) X Solvent Weld (slip), Female Pipe Thread (FPT) X Female Pipe Thread (FPT), Solvent Weld (slip) X Female Pipe Thread</li> </ul>	<p><b><u>SIZES:</u></b></p> <ul style="list-style-type: none"> <li>• 3/4"</li> <li>• 1"</li> <li>• 1-1/2"</li> <li>• 2"</li> </ul> <p><b><u>COLOR-CODED:</u></b></p> <ul style="list-style-type: none"> <li>• White- all services</li> <li>• Gray- all services</li> </ul> <table border="0"> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">TEE</td> <td style="text-align: center;">O-RING</td> <td style="text-align: center;">ELBOW</td> <td style="text-align: center;">CROSS</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">COUPLING</td> <td style="text-align: center;">ADAPTER</td> <td style="text-align: center;">BUSHING</td> <td style="text-align: center;">CAP</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">PLUG</td> <td style="text-align: center;">FLANGE</td> <td style="text-align: center;">WYE</td> <td style="text-align: center;">UNION</td> </tr> </table>					TEE	O-RING	ELBOW	CROSS					COUPLING	ADAPTER	BUSHING	CAP					PLUG	FLANGE	WYE	UNION
																									
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<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Pump station chemical feed applications downstream from backflow prevention devices</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• CHEMTROL/ NIBCO</li> <li>• CHARLOTTE PIPE AND FOUNDRY</li> <li>• IPEX</li> <li>• LASCO</li> <li>• SPEARS</li> </ul>																								

<p><b>B 3 – HIGH DENSITY POLYETHYLENE (HDPE) FLANGE AND MECHANICAL JOINT ADAPTERS (AWWA C906):</b></p>		<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
<p><b><u>SPECIFICATION/MATERIAL:</u></b> High Density Polyethylene (HDPE) fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• PE-3608 Resin listed in Plastic Pipe Institute TR4.</li> <li>• Cell classification per ASTM Standards D-3350 = 345464C or 345464C (black).</li> <li>• ASTM Standards D3035, minimum wall values.</li> <li>• AWWA C906.</li> <li>• Stainless Steel inserts are required.</li> <li>• MFG. Shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements for pipe in this classification.</li> </ul> <p><b><u>POTABLE WATER REQUIREMENTS:</u></b></p> <ul style="list-style-type: none"> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 14, 61 or "NSF-pw".</li> </ul> <p><b><u>COLOR-CODED:</u></b></p> <ul style="list-style-type: none"> <li>• Black- all service</li> </ul> <p><b><u>DIMENSIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Ductile iron pipe size O.D., D.I.P.S.</li> <li>• DR-9, DR-11</li> </ul> <p><b><u>SIZES:</u></b></p> <ul style="list-style-type: none"> <li>• 4" thru 24"</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• 160-psi. operating pressure @ 73.4 F for DR-11.</li> <li>• 200-psi. operating pressure @ 73.4 F for DR-9.</li> </ul> <p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>• Plain end (PE) X mechanical joint (MJ).</li> <li>• Plain end (PE) X flange joint (FL).</li> </ul> <p><b><u>INCLUDE:</u></b></p> <ul style="list-style-type: none"> <li>• Ductile iron gland ring.</li> <li>• Rubber gasket.</li> <li>• Proper size, length and number of 316 SS bolts and nuts.</li> </ul>	<p><b><u>FIRE MAIN PRESSURE RATING &amp; REQUIREMENTS:</u></b></p> <ul style="list-style-type: none"> <li>• Dimension Ratio (DR) DR-9, pressure class 200 for fire mains.</li> <li>• Factory Mutual Approved (FM).</li> <li>• Stainless Steel insert stiffener required.</li> </ul> <p style="text-align: center;"><b><u>FLANGE ADAPTER</u></b></p>  <p style="text-align: center;"><b><u>MECHANICAL JOINT ADAPTER</u></b></p>  	
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Mechanical joint adapters for butterfly valves must be specified to ensure proper valve operation.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• CENTRAL PLASTICS</li> <li>• CP CHEMICAL/PERFORMANCE PIPE</li> <li>• IPEX/FRIATEC</li> <li>• INDEPENDENT PIPE PRODUCTS</li> <li>• ORION ENTERPRISES, INC.</li> <li>• SPECIFIED FITTINGS</li> <li>• DRISCO PLEX</li> </ul>	

<p><b>B 4 – HIGH DENSITY POLYETHYLENE (HDPE) PIPE WALL STIFFENERS:</b></p>		<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
<p><b><u>SPECIFICATION/MATERIAL:</u></b> High Density Polyethylene (HDPE) pipe wall stiffeners shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Stiffeners shall be suitable for use with HDPE pipe made in accordance with ANSI/AWWA C906, SDR 9 and 11.</li> <li>• Shall be suitable for use with standard mechanical joint pipe or fittings made in accordance with ANSI/AWWA C111/A21.11, or ANSI/AWWA C153/A21.53 of the latest revision.</li> <li>• ASTM Standard A 240 type 304 or 316 stainless steel.</li> </ul> <p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>• Shall be either one or two-piece design.</li> <li>• Shall fit securely in the inside of pipe.</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• Stiffeners shall be suitable for use at pressures up to 150 psi.</li> </ul>	 <p><b>STYLE CPS-IPS</b></p> <p><b>JCM 230/231 Stiffener</b></p>	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• CASCADE- CPS-IPS SERIES</li> <li>• JCM- 230 &amp; 231 SERIES</li> <li>• ROMAC STAINLESS STEEL STIFFENER</li> <li>• DRISCO PLEX</li> <li>• A.Y. MCDONALD</li> <li>• FORD METER BOX</li> </ul>	

**B 5 – PLASTIC FITTINGS (SDR-21):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Plastic fittings (SDR-21) shall meet or exceed the performance specifications of:

- ASTM Standards D 1784, manufactured from compounds with cell classification 12454B (type 1, grade 1 material).
- Joints per ASTM Standards D 3139 testing requirements.
- Gaskets per ASTM Standards F477.
- No solvent-cement weld pipe or fittings will be accepted.
- Standard Dimension Ratio (SDR) 21.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines.

**PRESSURE RATING:**

- 200 psi. at 23 Degrees C (73.4 Degrees F)

**CONNECTIONS:**

- Male Iron Pipe Thread (MIPT) X Push-on integral bell type supplied with elastomeric gaskets installed.
- Push-on integral bell X Push-on integral bell supplied with elastomeric gaskets installed.

**COLOR-CODED:**

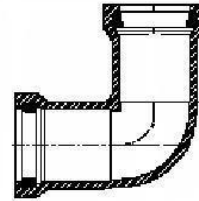
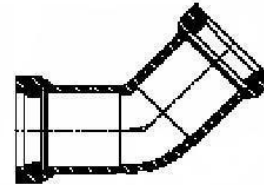
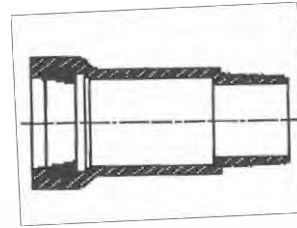
- White- all services

**DIMENSIONS:**

- Iron pipe size (IPS) Outside diameter controlled.

**RESTRICTIONS:**

- Only male threads will be accepted in this section.
- Use of this product is limited to two-inch diameter pressure applications.
- Prior approval required.



**MANUFACTURER:**

- FLO-CONTROL
- HARCO
- MULTI FITTING- CYCLE TOUGH 4000

**B 6 – PVC FITTINGS - GASKETED PVC (AWWA C 900):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Plastic fittings (AWWA C 900) shall meet or exceed the performance specifications of:

- Shall be manufactured in one piece of injection molded or fabricated from a PVC compound meeting ASTM Standards D 1784.
- Gaskets per ASTM Standards F477.
- ASTM Standards D 1784, manufactured from compounds with cell classification 124548 (type 1, grade 1 material).
- No solvent-cement weld pipe or fittings will be accepted on sizes less than or equal to 8".
- Joint per ASTM Standards D3139 bell joint using elastomeric gaskets.

**WALL THICKNESS DIMENSIONS:**

- C-900 DR18, 150 psi, minimum requirement.

**CONNECTIONS:**

- Male Iron Pipe Thread (MIPT) X Push-on integral bell type supplied with elastomeric gaskets installed.
- Female Iron Pipe Thread (FIPT) X Push-on integral bell type supplied with elastomeric gaskets installed.
- Push-on integral bell X Push-on integral bell supplied with elastomeric gaskets installed.
- Spigot X Push-on integral bell supplied with elastomeric gaskets installed.



**MANUFACTURER:**

- FREEDOM PLASTICS, INC.
- HARCO
- MACON PLASTICS, INC .
- MUL TI-FITTINGS
- PLASTIC TRENDS, INC .
- SPECIFIED FITTINGS, INC.
- GPK PRODUCTS

**RESTRICTIONS:**

- Only for use with gravity sewer laterals and mains.
- Fabricated fittings are not acceptable in sizes smaller than 10".

**B 7 – BRASS FITTINGS/ MISCELLANEOUS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Nipples, caps, plugs, tees, bend, and bushings shall meet or exceed the performance specifications of:

- Brass body conforming to AWWA C800 (ASTM Standards B62 85-5-5-5) or the latest revisions thereof.
- All threads shall be standard iron pipe thread.
- All nipples shall conform to ASTM Standards B43 (Red Brass Nipples) or latest revision thereof.

**CONNECTIONS:**

- Male iron pipe thread X male iron pipe thread.
- Female iron pipe thread X female iron pipe thread.
- Male iron pipe thread X female iron pipe thread.



**MANUFACTURER:**

- A.Y. MCDONALD
- BOSHART INDUSTRIES
- CAMBRIDGE BRASS
- FORD
- LEE BRASS
- MERIT BRASS

**RESTRICTIONS:**



<b>B 8 – FLANGED JOINT FITTINGS (AWWA C110):</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION/MATERIAL:</u></b> Flanged fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Fittings shall be ductile iron per ASTM A536 or cast iron per ASTM A 126.</li> <li>• Shall be produced in accordance with laying lengths specified in ANSI/ AWWA C110/ A 21.1 0.</li> <li>• Rubber gasket joints in accordance with ANSI/AWWA C111/A21.11.</li> <li>• Flange surface shall be faced and drilled in accordance with ANSI Class 125 B16.1.</li> <li>• Nuts, bolts and gaskets shall be designed to withstand the design and test pressures of the pipe.</li> <li>• All fittings shall have distinctly cast upon them the manufacture's identification, pressure rating, nominal diameter and number of degrees or fraction of a circle on all bends.</li> <li>• Fittings supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UUFM) for sizes four 4" thru 12". Markings must be cast on the fitting at time of manufacture to meet this requirement.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> <li>• Bosses and base elbows may be required.</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• Minimum of 250-psi. for sizes 4" thru 24".</li> </ul>	<p><b><u>COATING &amp; LINING:</u></b> <b>Potable and Reclaimed Water:</b></p> <ul style="list-style-type: none"> <li>• Exterior coating: asphaltic or red epoxy coating.</li> <li>• AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> <li>• AWWA C116 (ANSI-A21 .16) epoxy coating both inside and out.</li> </ul> <p><b>Sanitary Sewer and Force Mains:</b></p> <ul style="list-style-type: none"> <li>• Exterior coating: asphaltic or red epoxy coating.</li> <li>• Sewer pipe shall have the interior coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment "PROTECTO 401" (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres "TNEMEC SERIES 431 PERMASHIELD PL" (40 mils nominal).</li> </ul>	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AMERICAN CAST IRON</li> <li>• CLOW</li> <li>• MCWANE, INC.</li> <li>• SIGMA CORP</li> <li>• STAR PIPE PRODUCTS</li> <li>• TYLER UNION FOUNDRY</li> <li>• US PIPE</li> <li>• SIP INDUSTRIES</li> </ul>	

**B 8.1 – FLANGE JOINT ACCESSORY KITS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Flange Joint Accessory Kits shall meet or exceed the performance specifications of:

- Designed to work with flange pipe and fittings per ANSI/ AWWAC110/A21.10 and ANSI B16.1 125 pound class.
- Rubber gasket joints in accordance with ANSI/AWWA C111/A21.11.
- Nuts, bolts and gaskets shall be designed to withstand the design and test pressures of the pipe.
- Flat ring gaskets are acceptable, but full face gaskets are preferred.

**HEX BOLTS, NUTS & LOCK WASHERS:**

- Threads per ANSI B1 .1 course thread series, Class 2A external and Class 2B internal.
- Stainless steel, Type 316.

**GASKET:**

- Synthetic red rubber per ASTM 13303.
- SBR- Buna-S.
- EPDM (ethylene propylene).
- NBR- Nitrile Buna-N.
- Viton; Fluorel (FKM).

**REQUIREMENTS:**

- Each accessory kit shall be a boxed package.

**INCLUDE:**

- One (1) rubber gasket.
- Proper number and size of bolts and nuts required for each pipe fitting face.
- Proper number and size lock washers when required.

**ADDITIONAL REQUIREMENTS:**

- Lock washers are required when installed as part of a sewer pumping facility.



**MANUFACTURER:**

- AMERICAN CAST IRON
- CLOW
- GRIFFIN PIPE PRODUCTS
- MCWANE, INC.
- SIGMA CORP.
- STAR PIPE PRODUCTS
- TYLER UNION FOUNDRY
- US PIPE

**RESTRICTIONS:** \_



<p><b>B 9 – MECHANICAL JOINT FITTINGS (AWWA C110 FULL BODY), (4" THRU 36"):</b></p>	<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
<p><b><u>SPECIFICATION/MATERIAL:</u></b> Mechanical joint, full body, fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Fittings shall be ductile iron per ASTM A536.</li> <li>• Shall be produced in accordance with laying lengths and body thickness specified in ANSI/ AWWA C110/ A 21.10.</li> <li>• Rubber gasket joints in accordance with ANSI/ AWWA C111/A21.11.</li> <li>• All fittings shall have distinctly cast upon them the manufacture's identification, pressure rating, nominal diameter and number of degrees or fraction of a circle on all bends.</li> <li>• Ductile iron fittings shall have the letters "01" or "Ductile" cast on them.</li> <li>• Fittings supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Sizes four (4") thru twelve (12") inch Factory Mutual Approved (FM) or Underwriter Laboratory Listed (UL) is required. Marking must be cast on the fitting at time of manufacture to meet this requirement.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul>	<p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• Minimum of 350-psi. for sizes 4" thru 24".</li> <li>• Minimum of 250-psi. for sizes 30" thru 36".</li> </ul> 
<p><b><u>COATING &amp; LINING:</u></b> <b>Potable and Reclaimed Water:</b></p> <ul style="list-style-type: none"> <li>• Exterior coating: asphaltic coating.</li> <li>• AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> <li>• AWWA C116 (ANSI-A21.16) epoxy coating both inside and out.</li> </ul> <p><b>Sanitary Sewer and Force Mains:</b></p> <ul style="list-style-type: none"> <li>• Exterior coating: asphaltic coating.</li> <li>• Sewer pipe shall have the interior coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment "PROTECTO 401" or "PERMOX CTF" (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres "TNEMEC SERIES 431 PERMASHIELD PL" (40 mils nominal).</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AMERICAN CAST IRON</li> <li>• CLOW</li> <li>• MCWANE, INC.</li> <li>• SIGMA CORP.</li> <li>• STAR PIPE PRODUCTS</li> <li>• TYLER UNION FOUNDRY</li> <li>• US PIPE</li> </ul>

<p><b>B 9 – CONTINUED:</b></p>	
<p><b><u>RESTRICTIONS:</u></b></p>	

<b>B 10 – MECHANICAL JOINT FITTINGS (AWWA C153 COMPACT BODY), (4" THRU 48"):</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION/MATERIAL:</u></b>                  Mechanical joint, compact or short body, fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Fittings shall be ductile iron.</li> <li>• Shall be produced in accordance with laying lengths and body thickness specified in ANSI/ AWWA C153/ A 21.53.</li> <li>• Rubber gasket joints in accordance with ANSI/ AWWA C111/ A21 .11.</li> <li>• Exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc shall be 200 g/m2 of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The zinc coating system shall conform to ISO 8179-1 "Ductile iron pipe – External zinc based coating – Part 1: Metallic zinc with finishing layer.</li> <li>• All fittings shall have distinctly cast upon them the manufacture's identification, pressure rating, nominal diameter and number of degrees or fraction of a circle on all bends.</li> <li>• Ductile iron fittings shall have the letters "DI" or "Ductile" cast on them.</li> <li>• Fittings supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Sizes 4" thru 12" Factory Mutual Approved (FM) or Underwriter Laboratory Listed (UL) is required. Marking must be cast on the fitting at time of manufacture to meet this requirement.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>• Minimum of 350-psi. for sizes 4" thru 24".</li> <li>• Minimum of 250-psi. for sizes 30" thru 36".</li> </ul>	<p><b><u>COATING &amp; LINING:</u></b>  <b>Potable Water:</b></p> <ul style="list-style-type: none"> <li>• Exterior - AWWA C151 (ANSI-A21.51) per above ISO 8179- 1 requirements.</li> <li>• Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> </ul> <p><b>Sanitary Sewers and Force Mains:</b></p> <ul style="list-style-type: none"> <li>• Exterior - AWWA C151 (ANSIA21.51) per above ISO 8179-1 requirements.</li> <li>• Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment "PROTECTO 401" or "PERMOX CTF" (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres "TNESEC SERIES 431 PERMA-SHIELD PL" (40 mils nominal).</li> <li>• The inside of the bell socket including a portion of the gasket cavity and a portion of the pipe barrel are coated with 8-mils (minimum) of epoxy.</li> </ul> <div style="text-align: center;">  </div>	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AMERICAN CAST IRON</li> <li>• CLOW</li> <li>• MCWANE, INC.</li> <li>• SIGMA CORP.</li> <li>• STAR PIPE PRODUCTS</li> <li>• TYLER UNION FOUNDRY</li> <li>• US PIPE</li> <li>• SIP INDUSTRIES</li> </ul>	

**B 11 – MECHANICAL JOINT ACCESSORY KITS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Mechanical Joint Ductile Iron Pipe Fitting Accessory Kits shall meet or exceed the performance specifications of:

- Rubber gasket joints in accordance with ANSI/AWWA C111/A21.11 and the latest revisions thereto.
- Accessory kits for 4" through 12" sizes shall also conform to ANSI/AWWA C153/A21.53 and the latest revisions thereto.
- Accessory kits for 14" through 36" sizes shall also conform to ANSI/AWWA C110/A21.10 and the latest revisions thereto.
- Nuts, bolts and gaskets shall be designed to withstand the design and test pressures of the pipe.
- Mechanical joint glands shall be ductile iron.
- Tee bolts and nuts shall be 316 SS.
- Glands supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.



**GASKET MATERIAL:**

- SBR- Buna-S.
- EPDM (ethylene propylene).
- NBR- Nitrile Buna-N.
- Viton; Fluorel (FKM).

**INCLUDE:**

- One (1) ductile iron gland.
- One (1) rubber gasket:
- Proper number of 316SS bolts and nuts required for each pipe fitting face.

**MANUFACTURER:**

- AMERICAN CAST IRON
- CLOW
- GRIFFIN PIPE PRODUCTS
- MCWANE, INC.
- SIGMA CORP.
- STAR PIPE PRODUCTS
- TYLER UNION FOUNDRY
- US PIPE
- MIDWEST (BOLTS)
- ACTIVE SCREW (BOLTS)

**RESTRICTIONS:**

**B 12 – MECHANICAL JOINT CONNECTOR:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Restraint devices for nominal pipe sizes 4” thru 24” shall consist of joining two mechanical joint fittings or a fitting to a valve, incorporated into a gland that shall meet or exceed the following:

**MATERIAL:**

- Ductile iron conforming to ASTM Standards A 80-55-06 and the Latest revision thereto.
- Supplied with a fusion epoxy coating both inside and out in accordance with AWWA C116 (ANSIA21.16).

**NUTS AND BOLTS:**

- 316 stainless steel conforming to AWWA C111/A21.11 AND ASTM Standards A242.

**GASKET:**

Standard mechanical joint (MJ) gaskets conforming to:

- AWWA C111/ ASTM Standards F-477, made of:
- SBR– Buna-S.
- EPDM– Ethylene Propylene.
- NBR– Nitrile Buna-N.

**INCLUDE:**

- 1 each – Foster Adaptor.
- 2 each – Proper size MJ Gaskets.
- Proper number and size 316 stainless steel bolts and nuts.


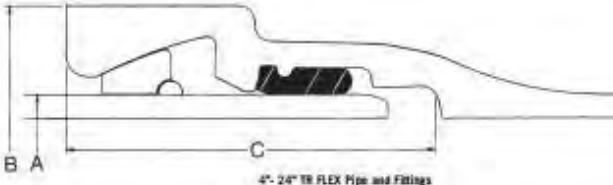
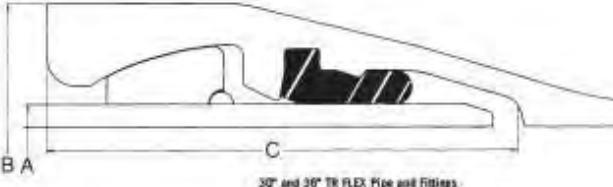


**MANUFACTURER:**

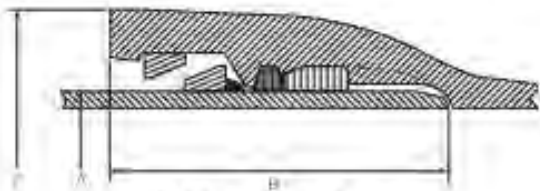

- INFACOT CORPORATION– FOSTER ADAPTER
- OPEN

**RESTRICTIONS:**

- May not fit both “run” and “branch” on compact tees or crosses.
- Must have epoxy coating (not visible in all photos).
- CFPUA approval required.

<b>B 13 – PUSH-ON JOINT RESTRAINED FITTINGS (4" THRU 36") TR FLEX:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b>SPECIFICATION/MATERIAL:</b> Push-on restrained fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>Fittings shall be ductile iron, per ASTM A536, and have a modified Tyton Joint socket connection.</li> <li>Shall use ductile iron locking segments, inserted through a slot (or slots) in the bell face, to provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.</li> <li>Shall be produced in accordance with principals specified in ANSI/ AWWA C110/ A 21.10 and ANSI/ AWWA C153/ A21.53.</li> <li>Exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc shall be 200 g/m<sup>2</sup> of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The zinc coating system shall conform to ISO 8179-1 "Ductile iron pipe – External zinc based coating – Part 1: Metallic zinc with finishing layer.</li> <li>Rubber gasket joints in accordance with ANSI/ AWWA C111/A21.11.</li> <li>All fittings shall have distinctly cast upon them the manufacture's identification, pressure rating, nominal diameter and number of degrees or fraction of a circle on all bends.</li> <li>Fittings supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b>PRESSURE RATING:</b></p> <ul style="list-style-type: none"> <li>Minimum of 350-psi for sizes 4" thru 24".</li> <li>Minimum of 250-psi for sizes 30" thru 36".</li> </ul>	<p><b>COATING &amp; LINING:</b> <b>Potable Water:</b></p> <ul style="list-style-type: none"> <li>Exterior - AWWA C151 (ANSI-A21.51) per above ISO 8179- 1 requirements.</li> <li>Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> </ul> <p><b>Sanitary Sewers and Force Mains:</b></p> <ul style="list-style-type: none"> <li>Exterior - AWWA C151 (ANSIA21.51) per above ISO 8179-1 requirements.</li> <li>Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment "PROTECTO 401" or "PERMOX CTF" (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres "TNEMEC SERIES 431 PERMA-SHIELD PL" (40 mils nominal).</li> </ul> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p>4" TR FLEX Pipe and Fittings</p> </div> <div style="text-align: center;">  <p>30" and 36" TR FLEX Pipe and Fittings</p> </div>	
<p><b>RESTRICTIONS:</b></p> <ul style="list-style-type: none"> <li>US Pipe-Red Field Lok 350 gasket shall be used for field cut pipe connections which do not have a factory weldment.</li> <li>Plain end fittings not allowed.</li> </ul>	<p><b>MANUFACTURER:</b></p> <ul style="list-style-type: none"> <li>AMERICAN CAST IRON – FLEX-RING</li> </ul>	



<p><b>B 14 – PUSH-ON JOINT RESTRAINED FITTINGS (4" THRU 48") FLEX-RING:</b></p>		<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
<p><b><u>SPECIFICATION/MATERIAL:</u></b> Push-on restrained fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>Fittings shall be ductile iron, per ASTM A536, and have a modified Fastite Joint socket connection.</li> <li>Shall use ductile iron locking segments, inserted through a slot (or slots) in the bell face, to provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.</li> <li>Shall be produced in accordance with principals specified in ANSI/ AWWA C110/ A 21.10 and ANSI/ AWWA C153/ A21.53.</li> <li>Exterior shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc shall be 200 g/m<sup>2</sup> of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The zinc coating system shall conform to ISO 8179-1 "Ductile iron pipe – External zinc based coating – Part 1: Metallic zinc with finishing layer.</li> <li>Rubber gasket joints in accordance with ANSI/ AWWA C111/A21.11.</li> <li>All fittings shall have distinctly cast upon them the manufacture's identification, pressure rating, nominal diameter and number of degrees or fraction of a circle on all bends.</li> <li>Fittings supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>PRESSURE RATING:</u></b></p> <ul style="list-style-type: none"> <li>Minimum of 350-psi for sizes 4" thru 24".</li> <li>Minimum of 250-psi for sizes 30" thru 48".</li> </ul>	<p><b><u>COATING &amp; LINING:</u></b> <b>Potable Water:</b></p> <ul style="list-style-type: none"> <li>Exterior - AWWA C151 (ANSI-A21.51) per above ISO 8179- 1 requirements.</li> <li>Interior - AWWA C104 (ANSI-A21.4), cement mortar lining and asphaltic coating.</li> </ul> <p><b>Sanitary Sewers and Force Mains:</b></p> <ul style="list-style-type: none"> <li>Exterior - AWWA C151 (ANSIA21.51) per above ISO 8179-1 requirements.</li> <li>Interior - Coated (factory applied) or approved equal with an amine cured novolac epoxy, containing at least 20% by volume of ceramic quartz pigment "PROTECTO 401" or "PERMOX CTF" (40 mils nominal) or polyamine ceramic epoxy containing at least 20% by volume ceramic hollow microspheres "TNEMEC SERIES 431 PERMA-SHIELD PL" (40 mils nominal).</li> </ul> <div style="text-align: center;">  <p><b>4"-12" Flex-Ring</b></p> </div> <div style="text-align: center;">  <p><b>16"-48" Flex-Ring</b></p> </div>	
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>American Amarillo Fast Grip gaskets shall be used for field cut pipe connections, which do not have a factory weldment.</li> <li>Plain end fittings are not allowed.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>AMERICAN CAST IRON – FLEX-RING</li> </ul>	

**B 15 - UNI-FIT WIDE RANGE ADAPTER:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Uni-fit wide range adapter shall meet or exceed the performance specifications of:

- Fittings shall be ductile iron per ASTM A536.
- Shall be manufactured in accordance with AWWA C110.
- Flange surface shall be flat faced and drilled in accordance with ANSI Class 125 B16.1.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.

**MATERIAL:**

**Gasket:**

- EPDM (ethylene propylene)
- Styrene Butadiene Rubber (SBR)

**Bolts:**

- Stainless Steel Type 304

**Nuts and Washers:**

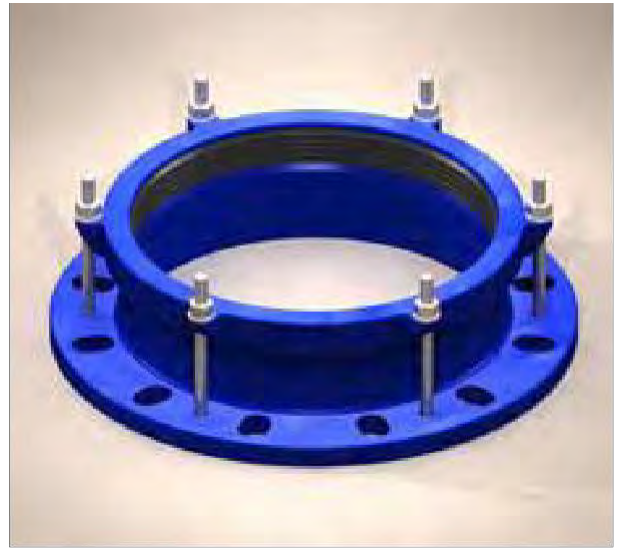
- Stainless Steel Type 304

**Coating:**

- Fusion Bonded Epoxy Coating Brass in compliance with AWWA C550

**REQUIREMENTS:**

- Minimum working pressure of 150 psi.



**MANUFACTURER:**

- NAPAC, INC. - Model 4428

**RESTRICTIONS:**

Use of this product is limited to:

- Installation of 3" and larger water meters



<b>Section C: Joint Restraints</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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- [C 1 Joint Restraints/ Bell & Spigot Joint/ New & In-Service Installations \(2" IPS PVC Pipe\)](#)
- [C 1.1 Joint Restraints/ Bell & Spigot Joint/ New & In-Service Installations \(AWWA C-900 PVC Pipe\)](#)
- [C 1.1.1 Joint Restraints/ Bell & Spigot Joint/ New & In-Service Installation \(AWWA C-900 PVC & DI Pipe\)](#)
- [C 1.2 Joint Restraints/ Bell & Spigot Joint/ New Installations Only \(AWWAC-900 PVC Pipe\)](#)
- [C 1.3 Joint Restraints/ Plain End to Mechanical Joint \(AWWA C-900 PVC Pipe\)](#)
- [C 2 Joint Restraints/ Multiple Wedge Style Mechanical Joint \(AWWA C-900 PVC Pipe\)](#)
- [C 2.1 Joint Restraints/ Multiple Wedge/MJ/ Split Gland/ Existing Installations Only \(AWWA C-900 PVC Pipe\)](#)
- [C 3 Joint Restraints/Multiple Wedge Style/ Bell & Spigot Joint/ New Installation/ \(DI Pipe\)](#)
- [C 3.1 Joint Restraints/Multiple Wedge Style/ Bell & Spigot Joint/ Existing Installations/ \(DI Pipe\)](#)
- [C 4 Joint Restraints/Multiple Wedge Style Mechanical Joint \(DI Pipe\)](#)
- [C 4.1 Joint Restraints/Multiple Wedge Style MJ/ Split Gland Existing Installations Only \(DI Pipe\)](#)
- [C 5 Joint Restraint Gaskets / DI Pipe \(Push On Joint\)](#)

**C 1 – JOINT RESTRAINTS/ BELL/ SPIGOT JOINT/ NEW & IN-SERVICE INSTALLATIONS/ 2” IPS PVC PIPE:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Restraint devices for nominal IPS pipe joints and fittings on size 2 inch shall consist of two split rings with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer on one pipe to the other, shall meet or exceed the performance specifications of:

- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.

**MATERIAL:**

- Ductile iron- ASTM Standards A536. Grade 65-45-12.
- T-bolts, rods and hex nuts- 316 SS.

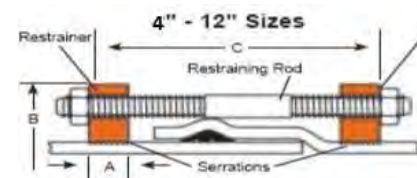
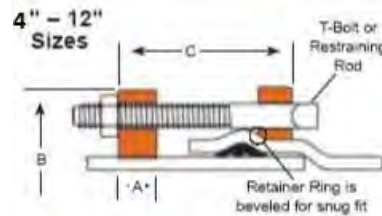
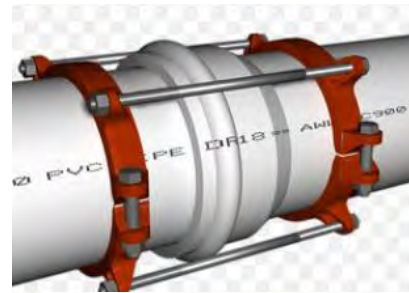
**DESIGN:**

- Restraint devices for PVC pipe shall consist of two split rings a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer on one pipe to the retainer on the next pipe or fitting.
- Shall be capable of installation on a new installation and in-service pipelines without disrupting pipe line service.

**INCLUDE:**

- Four (4)- Split ring halves
- Two (2)- Side clamping bolts and nuts
- Two (2) - Proper number, length and size, T-bolts and nuts or tie rods and nuts.

**RESTRICTIONS:**



**MANUFACTURER:**

- EBAA IRON- 6500, 7500 SERIES
- FORD- UNIFLANGE 1350, 1360, 1390 SERIES
- SIGMA- PVP SERIES (BELL & SPIGOT ONLY)

**C 1.1 – JOINT RESTRAINTS / BELL / SPIGOT JOINT / NEW & IN-SERVICE INSTALLATIONS/ (AWWA C-900) PVC PIPE:** Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4 inch through 12 inch shall consist of two split rings with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer on one pipe to the other, shall meet or exceed the performance specifications of:

- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.

**MATERIAL:**

- Ductile Iron- ASTM Standards A536. Grade 65-45-12.
- T-bolts, rods and hex nuts- 316 SS.

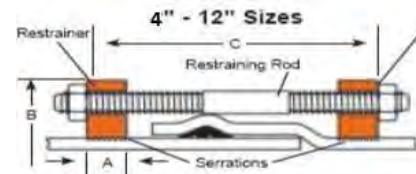
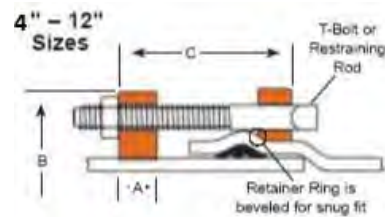
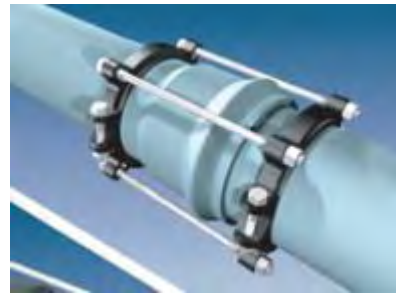
**DESIGN:**

- Restraint devices for PVC pipe shall consist of two split rings with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer on one pipe to the retainer on the next pipe.
- Shall be capable of installation on a new installation and in-service pipelines without disrupting pipe line service.

**INCLUDE:**

- Four (4)- Split ring halves
- Four (4)- Side clamping bolts and nuts
- Proper number, length and size, T-bolts and nuts or tie rods and nuts.

**RESTRICTIONS:**



**MANUFACTURER:**

- EBAA IRON- 1500 & 1600 SERIES
- FORD- UNIFLANGE 1390 SERIES
- STAR PRODUCTS-1100, 1100G2, & 1200 SERIES
- SIGMA- PV-LOK- PWP SERIES
- SMITH-BLAIR- 165 BELL-LOCK
- ROMAC 600 SERIES

**C 1.1.1 – Joint Restraints/ Bell & Spigot Joint/ New & In-Service Installation (AWWA C-900) PVC & DI Pipe:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Dual use (PVC & DI pipe) bell and spigot restraint devices for nominal pipe sizes 4” through 12” shall meet or exceed the performance specifications of:

- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.
- Shall be capable of new and in-service installations on PVC and DI pipe.

**MATERIAL:**

- Ductile Iron- ASTM Standards A536. Grade 65-45-12.
- T-bolts, rods and hex nuts- 316 SS.

**DESIGN:**

- Restraint devices for PVC & DI pipe shall consist of a split ring behind the pipe bell and a split ring with multiple gripping wedges and/or a series of serrations to grip the pipe spigot in conjunction with a sufficient number of bolts connecting the bell ring on one pipe to the retainer on the next pipe.
- Shall be capable of installation on a new installation and in-service pipelines without disrupting pipe line service.
- Gripping wedges and/or a series of serrations are optional on the bell ring, required on spigot ring.

**REQUIREMENTS:**

- Each accessory kit shall be a boxed package.

**INCLUDE:**

- Four (4) - Split ring halves.
- Four (4) - Side clamping bolts and nuts.
- Proper number, length and size, T-bolts and nuts or tie rods and nuts.



**MANUFACTURER:**

- EBAA IRON-1500TD & 1600TD SERIES
- SIGMA PV-LOK MODEL PWP

**RESTRICTIONS:**

<b>C 1.2 – JOINT RESTRAINTS / BELL &amp; SPIGOT JOINT / NEW INSTALLATIONS ONLY / (AWWA C-900) PVC PIPE:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” thru 12” shall consist of one solid ring and one split or solid ring with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer on the spigot pipe to the bell of the other, shall meet or exceed the performance specifications of:

- Material supplied must have ISO 9001 or later certification. or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.

**MATERIAL:**

- Ductile Iron- ASTM Standards A536. Grade 65-45-12.
- T -bolts, rods and hex nuts- 316 SS.

**DESIGN:**

- Restraint devices for PVC pipe shall consist of one split ring or two solid rings with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer on one pipe to the retainer on the next pipe.
- Shall be capable of installation on new installation pipelines.

**INCLUDE:**

- Two (2) - Split grip ring halves or One solid ring.
- One (1) - Solid behind the bell ring.
- Two (2) - Side clamping bolts and nuts, if required.

Proper number, length and size. T-bolts and nuts or tie rods and nuts.



**MANUFACTURER:**

- FORD- UNIFLANGE 1350 SERIES- Not for use on DR-14 PVC pipe.
- STAR PRODUCTS- PVC STARGRIP-4100P
- ROMAC 600 SERIES

**RESTRICTIONS:**

<b>C 1.3 – JOINT RESTRAINTS / PLAIN END TO MECHANICAL JOINT / (AWWA C-900) PVC PIPE:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” thru 12” shall consist of a split ring with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer to the joint, shall meet or exceed the performance specifications of:

- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.

**MATERIAL:**

- Ductile Iron- ASTM Standards A536. Grade 65-45-12.
- T -bolts, rods and hex nuts- 316 SS.

**DESIGN:**

- Restraint devices for PVC pipe shall consist of a split ring with multiple gripping wedges or a series of serrations to grip the pipe in conjunction with a sufficient number of bolts connecting the retainer to the joint.

**INCLUDE:**

- Two (2) - Split ring halves
- Two (2) - Side clamping bolts and nuts
- Proper number, length and size, T-bolts and nuts or tie rods and nuts.




**MANUFACTURER:**

- EBAA IRON- 15PFOO SERIES
- FORD- UNIFLANGE 1300 SERIES
- STAR PRODUCTS- 1000C SERIES
- SIGMA- PV-LOK - PWM SERIES
- SMITH-BLAIR- 115 BELL-LOCK

**RESTRICTIONS:**

- For use in existing, in-service pipelines only.



<b>C 2 – JOINT RESTRAINTS / MULTIPLE WEDGE STYLE MECHANICAL JOINT / (AWWA C-900) PVC PIPE:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b>                  Restraint devices for nominal pipe sizes 4” thru 12” shall consist of multiple gripping wedge incorporated into a follower gland shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Application requirements of AWWA C110 (ANSI-A21.10) or latest revision thereof.</li> <li>• AWWA C 153 (ANSI-A21.53) or latest revision thereof.</li> <li>• AWWA C111 (ANSI-A21.11) or latest revision thereof.</li> <li>• ASTM Standards F 1674-96 "Standard Test Method for Joint Restraint Products for use with PVC pipe".</li> <li>• Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) for sizes through 12”.</li> <li>• Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>MATERIAL:</u></b></p> <ul style="list-style-type: none"> <li>• Gland: Ductile iron conforming to the applicable provisions of AWWA C 111 (ANSI - A21.11) and ASTM A536.80.</li> <li>• Wedges: Ductile iron heat treated to a minimum hardness of 370 BHN.</li> </ul> <p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>• Multiple gripping wedges incorporated within a mechanical joint follower gland, that when actuated, impart increasing resistance to pipe separation as pressure increases restraint nuts must be shear type torque design.</li> <li>• Must include a minimum safety factor of 2:1 in all sizes.</li> </ul>	<p><b><u>INCLUDE:</u></b></p> <ul style="list-style-type: none"> <li>• One (1) ductile iron gland</li> <li>• One (1) rubber gasket</li> <li>• Proper number of 316 SS T-bolts and nuts for each MJ pipe fitting face.</li> </ul> <div style="text-align: center;">  </div>	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• EBAA IRON- MEGA LUG 2000PV SERIES</li> <li>• FORD- UNIFLANGE 1500 SERIES</li> <li>• SMITH-BLAIR- CAM-LOCK 120</li> <li>• STAR PIPE PRODUCTS- STARGRIP 4000 AND 4000G2 SERIES</li> <li>• SIGMA ONE LOK SERIES SLCE</li> </ul>	

**C 2.1 – JOINT RESTRAINTS/ MULTIPLE WEDGE STYLE MECHANICAL JOINT/ SPLIT GLAND/ EXISTING INSTALLATIONS ONLY/ (AWWA C-900) PVC PIPE:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” through 12” shall consist of multiple gripping wedge incorporated into a follower gland shall meet or exceed the performance specifications of:

- Application requirements of AWWA C110 (ANSI-A21.10) or latest revision thereof.
- Application requirements of AWWA C153 (ANSI-A21.53) or latest revision thereof.
- Application requirements of AWWA C111 (ANSI-A21.11) or latest revision thereof.
- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

- Gland: Ductile iron conforming to the applicable provisions of ASTM A 536, Grade 65-45-12.
- Wedges: Ductile iron heat treated to a minimum hardness of 370 BHN.

**DESIGN:**

- Multiple gripping wedges incorporated within a split mechanical joint follower gland, that when actuated, impart increasing resistance to pipe separation as pressure increases restraint nuts must be shear type torque design.
- Must include a minimum safety factor of 2:1 in all sizes.

**RESTRICTIONS:**

- For use in existing, in-service pipelines only.

**INCLUDE:**

- One (1) ductile iron split gland
- One (1) rubber gasket
- Proper number of 316 SS T-bolts and nuts for each mechanical joint pipe fitting face.



**MANUFACTURER:**

- EBAA IRON - MEGA LUG 2000SV SERIES



<b>C 3 – JOINT RESTRAINTS/ MULTIPLE WEDGE STYLE/ BELL &amp; SPIGOT JOINT/ NEW INSTALLATIONS ONLY/ DI PIPE:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” thru 24” shall consist of multiple gripping wedge incorporated into one or two follower glands and shall meet or exceed the performance specifications of:

- Application requirements of AWWA C110 (ANSI-A21.10) or latest revision thereof.
- AWWA C153 (ANSI-A21.53) or latest revision thereof.
- AWWA C111 (ANSI-A21.11) or latest revision thereof.
- Material supplied must have ISO 9001 or later Certification, or poured in a foundry located in the U.S.A.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

- Glands: Ductile iron conforming to the applicable provisions of AWWA C 111 (ANSI-A21.11) and ASTM A536.80.
- Wedges: Ductile iron heat treated to a minimum hardness of 370 BHN.

**INCLUDE:**

- Two (2) ductile iron glands
- Proper number, length and size, 316 SS T-bolts and nuts or tie rods and nuts.

**OPTIONAL:**

- May be installed on existing pipelines if product is capable.



**MANUFACTURER:**

- EBAA IRON- 1700 SERIES
- FORD- UNIFLANGE 1450 SERIES
- SIGMA- ONE LOKI SLDEH
- STAR PRODUCTS- STAGRIP 3100P SERIES

**RESTRICTIONS:**

<p><b>C 3.1 – JOINT RESTRAINTS/ MULTIPLE WEDGE STYLE/ BELL &amp; SPIGOT JOINT/ SPLIT GLANDS/ EXISTING INSTALLATIONS/ DI PIPE:</b></p>	<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
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**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” thru 24” shall consist of multiple gripping wedge incorporated into one or two follower split glands and shall meet or exceed the performance specifications of:

- Application requirements of AWWA C110 (ANSI-A21.10) or latest revision thereof.
- Application requirements of AWWA C153 (ANSI-A21.53) or latest revision thereof.
- Application requirements of AWWA C111 (ANSI-A21.11) or latest revision thereof.
- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

- Glands: Ductile iron conforming to the applicable provisions ASTM A536, Grade 65-45-12.
- Wedges: Ductile iron heat treated to a minimum hardness of 370 BHN.

**INCLUDE:**

- Two (2) ductile iron split glands
- Proper number, length and size, 316 SS T-bolts and nuts or tie rods and nuts.

**OPTIONAL:**

- May be installed on new pipelines if product is capable.



**MANUFACTURER:**

- EBAA IRON- 1100HD SERIES
- STAR PRODUCTS- STAGRIP 3100S SERIES
- SIGMA ONE LOK SERIES SSLDH

**RESTRICTIONS:**

<b>C 4 – JOINT RESTRAINTS/ MULTIPLE WEDGE STYLE MECHANICAL JOINT/ DI PIPE:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” through 24” shall consist of multiple gripping wedge incorporated into a follower gland shall meet or exceed the performance specifications of:

- Application requirements of AWWA C110 (ANSI-A21.10) or latest revision thereof.
- AWWA C153 (ANSI-A21.53) or latest revision thereof.
- AWWA C111 (ANSI-A21.11) or latest revision thereof.
- Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UUFM) for sizes through 12”.
- Underwriter Laboratory Listed (UL) as noted by (UL) for sizes through 24”.
- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

- Gland: Ductile iron conforming to the applicable provisions of AWWA C 111 (ANSI-A21.11) and ASTM A536.B0.
- Wedges: Ductile iron heat treated to a minimum hardness of 370 BHN.

**DESIGN:**

- Multiple gripping wedges incorporated within a mechanical joint follower gland, that when actuated, impart increasing resistance to pipe separation as pressure increases restraint nuts must be shear type torque design.
- Must include a minimum safety factor of 2:1 in all sizes.

**INCLUDE:**

- One (1) ductile iron gland
- One (1) rubber gasket
- Proper number of 316 SS T-bolts and nuts for each MJ pipe fitting face.



**MANUFACTURER:**

- EBAA IRON- MEGA LUG 1100, 1100SD, 1100SDB
- FORD- UNIFLANGE 1400 SERIES
- GRIFFIN- WEDGE ACTION
- ROMAC- ROMA GRIP! DI PIPE
- SIGMA- ONE LOKI SLDE
- SMITH-BLAIR- CAM-LOCK 111
- STAR PIPE PRODUCTS- STARGRIP 3000 SERIES

**RESTRICTIONS:**

**C 4.1 – JOINT RESTRAINTS/ MULTIPLE WEDGE STYLE MECHANICAL JOINT/ SPLIT GLAND/ EXISTING INSTALLATIONS ONLY/ DI PIPE:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” through 24” shall consist of multiple gripping wedge incorporated into a mechanical joint follower gland, shall meet or exceed the performance specifications of:

- Application requirements of AWWA C110 (ANSI-A21, 10) or latest revision thereof.
- AWWA C 153 (ANSI-A21.53) or latest revision thereof.
- AWWA C 111 (ANSI-A21.11) or latest revision thereof.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.
- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

- Gland: Ductile iron conforming to the applicable provisions of ASTM A536, Grade 65-45-12.
- Wedges: Ductile iron heat treated to a minimum hardness of 370 BHN.

**INCLUDE:**

- One (1) ductile iron gland
- One (1) rubber gasket
- Proper number of 316 SS T bolts and nuts for each MJ pipe fitting face.



**MANUFACTURER:**

- EBAA IRON- MEGA LUG 1100S0 SERIES
- STAR PIPE PRODUCTS- STARGRIP 3000S SERIES
- SIGMA ONE LOK SERIES SSLD

**RESTRICTIONS:**

- For use in existing, in-service pipelines only.

<b>C 5 – JOINT RESTRAINTS GASKETS/ DI PIPE (PUSH ON JOINT):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Restraint devices for nominal pipe sizes 4” through 24” for push-on Tyton Joint or Fastite Joint pipe and fittings, consisting of multiple gripping wedges integral to the gasket that are compressed when the joint is pushed home, that shall meet or exceed the performance specifications of:

- AWWA C 111 (ANSI-A21.11) or latest revision thereof.
- Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) for sizes through 12”.
- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Application requirements of AWWA C110 (ANSI – A21.10) or AWWA C 153 (ANSI – A21.53), latest revision thereof.

**MATERIAL:**

**Gaskets:**

- SBR- Buna-S
- EPDM-Ethylene Propylene
- NBR-Buna-N

**Locking Segments:**

- Stainless Steel vulcanized into the gasket

**DESIGN:**

- Gaskets shall be colored. The color shall be consistent throughout the entire cross section of the gasket. The color shall not be attained by surface coating, it shall be inherent within the rubber.
- Restrained gaskets are for use only in push-on joints.
- Both American’s Amarillo Fast Grip Gaskets and US Pipe, Red Field Lok 350 gaskets are acceptable.

**RESTRICTIONS:**

- For low profile carrier pipes inside casings with prior approval by CFPUA.
- Amarillo Fast Grip gaskets shall only be installed in Fastite bell joints.
- Red Field Lok 350 & Blue Sure Stop 350 gaskets shall only be installed in Tyton bell joints.

**INCLUDE:**

- One-Restraint push-on joint gasket.



**MANUFACTURER:**

- AMERICAN CAST IRON AMARILLO FAST GRIP GASKET
- McWANE, INC. – BLUE SURE STOP 350 GASKET
- US PIPE – RED FIELD LOK 350 GASKET



<b>Section D: Valves and Accessories</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><a href="#"><u>D 1 Valves- Resilient Seat/ 2" (FIPT X FIPT)</u></a></p> <p><a href="#"><u>D 1.1 Valves - AWWA C509/ Resilient Seat/ 2" Thru 12" (MJ X MJ)</u></a></p> <p><a href="#"><u>D 1.2 Tap Valves - AWWA C509/ Resilient Seat/ 4" Thru 12" (FLG X MJ)</u></a></p> <p><a href="#"><u>D 1.3 Valves- Resilient Seat/ 2" Thru 12" (FLG X FLG)</u></a></p> <p><a href="#"><u>D 1.4 Valves- Resilient Seat/ 14" Thru 48" (MJ X MJ)</u></a></p> <p><a href="#"><u>D 1.5 Valves- Eccentric Plug/ 4" Thru 24" (FLG X FLG)</u></a></p> <p><a href="#"><u>D 2 Check Valve- Resilient Seat/ Potable Water 2" Thru 30" (FLG X FLG)</u></a></p> <p><a href="#"><u>D 3 Swing Check Valves - Potable Water 2" Thru 16" (FLG X FLG)</u></a></p> <p><a href="#"><u>D 3.1 Swing Check Valves - Sanitary Sewer 4" Thru 16" (FLG X FLG)</u></a></p> <p><a href="#"><u>D 3.2 Swing Check Valves/ Resilient Seat- Sanitary Sewer 3" Thru 12" (FLG X FLG)</u></a></p> <p><a href="#"><u>D 4 Combination Air Valves - Stainless Steel/ Sanitary Sewer/ For 2" Thru 12" Mains</u></a></p> <p><a href="#"><u>D 4.1 Combination Air Valves- Stainless Steel/ Sanitary Sewer/ For 12" And Larger Mains</u></a></p> <p><a href="#"><u>D 5 Air Release Valves (UL/FM) - Potable Water</u></a></p> <p><a href="#"><u>D 6 Air Release Valves (2") - Potable Water</u></a></p> <p><a href="#"><u>D 7 Full Flange Pressure Sensor</u></a></p> <p><a href="#"><u>D 8 Post Type Hydrants</u></a></p> <p><a href="#"><u>D9 Reduced Pressure Detector Assembly / 2 1/2" Thru 10"</u></a></p> <p><a href="#"><u>D10 Double Check Detector Assembly / 3" Thru 10"</u></a></p>	



<b>D 1 – VALVES - RESILIENT SEAT/ 2" (FIPT X FIPT):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

- Resilient seat or wedge (RW) line valves shall meet or exceed the performance specifications of AWWA C509 or C515 for resilient seat gate valves with non-rising stems (NRS).
- Both ends shall have Female Iron Pipe Threads (FIPT).
- ANSI/ AWWA C550, all interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Cast or ductile iron conforming to ASTM Standards A126 or A536.

**Wedge:**

- Ductile iron fully encapsulated (no exposed iron) or bronze vulcanized with EPDM (ethylene-propylene) rubber.

**Seal & O-rings:**

- Triple O-ring seals, Nitrile Buna-N or EPDM rubber.

**Stuffing Box & Operating Nut:**

- Cast or ductile iron conforming to ASTM Standards A126 or A536.

**Stem:**

- Bronze per ASTM Standards B584 or stainless steel per AISI 430F.

**Hex Head Nuts and Bolts:**

- 316 Stainless steel.

**DESIGN:**

- Resilient seat gate valve, NRS, open left (counterclockwise).
- Both ends shall have female iron pipe threads (FIPT).
- Pressure rated for 200 psi minimum.
- Two-inch (2") square operating nut.

**RESTRICTIONS:**

**SIZE:**

- 2"



**MANUFACTURER:**

- AMERICAN AFC-2500 SERIES
- AMERICAN AVK 03-063-39
- CLOW VALVE 2639 & 2640
- KENNEDY VALVE KS-RW 8057 or 7057
- M & H VALVE COMPANY 4067-07
- MUELLER A-2360 SERIES
- U.S. PIPE A-USP0-8



<b>D 1.1 – VALVES - AWWA C509/C515 RESILIENT SEAT/ 2" thru 12" (MJ X MJ):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Resilient seat or wedge (RW) line valves shall meet or exceed the performance specifications of AWWA C509 or C515 for resilient seat gate valves with non-rising stems (NRS) and meet the following specific provisions:

- Both ends shall be mechanical joint in accordance with ANSI/ AWWA C111/A21.11.
- ANSI/ AWWA C550, all interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM).
- Shall have UL, FM mark displayed visibly and permanently on the valve.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Ductile iron conforming to ASTM Standards A126 or A536.

**Wedge:**

- Cast or ductile iron fully encapsulated (no exposed iron) with EPDM (ethylene-propylene) rubber

**Seal & O-rings:**

- Triple O-ring seals Nitrile Buna-N or EPDM rubber.

**Stuffing Box & Operating Nut:**

- Cast or ductile iron conforming to ASTM Standards A126 or A536.

**Stem:**

- Copper alloy/ bronze.

**Hex Head Nuts and Bolts:**

- 316 Stainless steel.

**DESIGN:**

- Resilient seat gate valve, NRS, open left (counterclockwise)
- Both ends shall be mechanical joint (MJ).
- Pressure rated for 250 psi minimum.
- 2" square operating nut.

**SIZE:**

- 2" thru 12"

**INCLUDE:**

- Two– properly sized mechanical joint accessory kits.



**MANUFACTURER:**

- AMERICAN AFC 2500 SERIES
- AMERICAN AVK 25 or 45 SERIES
- CLOW VALVE 2638, 2639 & 2640 SERIES
- KENNEDY VALVE KS-RW 7571 & 8571 SERIES
- M & H VALVE COMPANY 4067 & 7000 SERIES
- MUELLER A-2361 SERIES
- US PIPE A-USPO-23 SERIES

**RESTRICTIONS:**

<b>D 1.2 – TAP VALVES - AWWA C509/C515 RESILIENT SEAT/ 4” THRU 12” (FLG X MJ):</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b></p> <ul style="list-style-type: none"> <li>Resilient seat or wedge (RW) tap valves shall meet or exceed the performance specifications of AWWA C509 or C515 for resilient seat gate valves with non-rising stems (NRS).</li> <li>One end shall be mechanical joint in accordance with ANSI/AWWA C111/A21.11.</li> <li>One end shall be flange design with a raised tapping alignment centering ring and conform to MSS SP-60 standard.</li> <li>ANSI/AWWA C550, all interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating.</li> <li>Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM).</li> <li>Shall have UL, FM mark displayed visibly and permanently on the valve.</li> <li>Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>MATERIAL:</u></b></p> <p><b>Body:</b></p> <ul style="list-style-type: none"> <li>Cast or ductile iron conforming to ASTM Standards A126 or A536.</li> </ul> <p><b>Wedge:</b></p> <ul style="list-style-type: none"> <li>Cast or ductile iron fully encapsulated (no exposed iron) with EPDM (ethylene-propylene) rubber.</li> </ul> <p><b>Seal &amp; O-rings:</b></p> <ul style="list-style-type: none"> <li>Triple O-ring seals Nitrile Buna-N or EPDM rubber.</li> </ul> <p><b>Stuffing Box &amp; Operating Nut:</b></p> <ul style="list-style-type: none"> <li>Cast or ductile iron conforming to ASTM Standards A536.</li> </ul> <p><b>Stem:</b></p> <ul style="list-style-type: none"> <li>Copper alloy/ bronze.</li> </ul> <p><b>Hex Head Nuts and Bolts:</b></p> <ul style="list-style-type: none"> <li>316 Stainless steel.</li> </ul>	<p><b><u>SIZE:</u></b></p> <ul style="list-style-type: none"> <li>4” thru 12”</li> </ul> <p><b><u>INCLUDE:</u></b></p> <ul style="list-style-type: none"> <li>One– properly sized mechanical joint accessory kit.</li> <li>One– properly sized flange joint accessory kit.</li> </ul> <p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>Resilient seat gate valve, NRS, open left counterclockwise).</li> <li>Pressure rated for 250 psi minimum.</li> <li>2” square operating nut.</li> </ul> <div style="text-align: center;">  </div>	
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>AMERICAN AFC-2500 SERIES</li> <li>AMERICAN AVK 45 (DI) SERIES</li> <li>CLOW VALVE 2638, 2639 &amp; 2640 SERIES</li> <li>KENNEDY VALVE KS-RW 7950 &amp; 8950 SERIES</li> <li>M &amp; H VALVE COMPANY 4751 &amp; 7590 SERIES</li> <li>MUELLER A-2361 SERIES</li> <li>US PIPE T-USPO-19 SERIES</li> </ul>	

<b>D 1.3 – VALVES - RESILIENT SEAT/ 2" thru 12" (FLG X FLG):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

- Resilient seat or wedge (RW) control valves shall meet or exceed the performance specifications of AWWA C509 or C515 for resilient seat gate valves with non- rising stems (NRS).
- Both ends shall be flanged, faced and drilled in accordance with ANSI Class 125 B16.1.
- ANSI/ AWWA C550, all interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Factory Mutual Approved (FM) and Underwrite Laboratory Listed (UL) as noted by \*(UL/FM).
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Cast or ductile iron conforming to ASTM Standards A126 or A536.

**Wedge:**

- Ductile iron fully encapsulated (no exposed iron) with EPDM (ethylene-propylene) rubber.

**Seal & O-rings:**

- Triple O-Ring seals Nitrile Buna-N or EPDM rubber.

**Stuffing Box & Operating Nut:**

- Ductile iron conforming to ASTM Standards A126 or A536.

**Stem:**

- Copper alloy/ bronze.

**Hex Head Nuts and Bolts:**

- 316 Stainless steel.

**DESIGN:**

- Resilient seat gate valve, NRS, open left (counterclockwise).
- Both ends shall be flange joint (FLG).
- Pressure rated for 250 psi minimum.
- Operated by a ductile or cast iron hand wheel.

**RESTRICTIONS:**

**SIZE:**

- 2" thru 12"
- Two (2) properly sized flange joint accessory kit.



**MANUFACTURER:**

- AMERICAN AFC-2500 SERIES
- AMERICAN AVK 25 (CI) & 45 (DI) SERIES
- CLOW VALVE 2638, 2639 & 2640 SERIES
- KENNEDY VALVE KS-RW
- M & H VALVE COMPANY
- MUELLER A-2360 SERIES
- US PIPE A-USPO-6 SERIES

<b>D 1.4 – VALVES- RESILIENT SEAT/ 14” thru 48” (MJ X MJ):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Resilient seat or wedge (RW) line valves shall meet or exceed the performance specifications of:

- Valves shall be ductile iron.
- AWWA C509 or C515 for resilient seat gate valves with non-rising stems (NRS).
- Both ends shall be mechanical joint in accordance with ANSI/AWWA C111/A21.11.
- ANSI/AWWA C550, all interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Ductile iron conforming to ASTM Standards A536.

**Wedge:**

- Ductile iron fully encapsulated (no exposed iron) with EPDM (ethylene-propylene) rubber.

**Seal & O-rings:**

- Triple O-ring seals Nitrile Buna-N or EPDM rubber.

**Stuffing Box & Operating Nut:**

- Ductile iron conforming to ASTM Standards A536.

**Stem:**

- Copper alloy in accordance with AWWA C515 Standards.

**Bonnet Hex Head Nuts and Bolts:**

- 316 Stainless steel (no socket head bolts allowed).

**DESIGN:**

- Resilient seat gate valve, NRS, open left (counterclockwise).
- Both ends shall be mechanical joint (MJ).
- Pressure rated for 150 psi minimum.
- 2” square operating nut.

**RESTRICTIONS:**

**SIZE:**

- 14” thru 48”

**ADDITIONAL REQUIREMENTS:**

- Valves 16” and larger require a gear operator.
- Valves 30” and larger require a bypass valve.
- Valves shall be installed vertical when used in raw sewer or sludge applications.



**MANUFACTURER:**

- AMERICAN AFC-2500 SERIES
- CLOW VALVE CO.
- KENNEDY RW
- MUELLER A-2361 SERIES
- US PIPE A-USP1 SERIES

<b>D 1.5 – VALVES- ECCENTRIC PLUG/ 4” thru 24” (FLG X FLG):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Eccentric plug valves shall meet or exceed the performance specifications of:

- Shall be designed and manufactured to have a minimum wall thickness per AWWA C 517-16.
- Interior ferrous metal surfaces shall be epoxy coated to comply with AWWA C550.
- Port area shall be a minimum 80% of full pipe area.
- Shall be non-lubricating type.
- Bearings shall be sintered, oil impregnated type 316 stainless steel.
- Stem packing seals shall be repackable while under pressure without removing the bonnet from the valve.
- Both ends shall be flanged, faced and drilled in accordance with ANSI Class 125 B16.1.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Cast iron or ductile iron conforming to ASTM Standards A126 or A536.

**Plug:**

- Cast iron or ductile iron encapsulated with Nitrile Buna-N or EPDM (ethylene-propylene) rubber.

**Seal & O-rings:**

- Nitrile Buna-N or EPDM rubber.

**DESIGN:**

- Both ends shall be flange joint (FLG).
- Pressure rated for 150 psi minimum.
- Shall rotate 90 degrees (quarter turn) from full-open to full-closed position.
- Operated by a ductile or cast iron lever.
- Plug valves 6” and larger shall be gear operated.



**MANUFACTURER:**

- CLOW VALVE CO.
- DEZURIK
- HENRY PRATT CO.
- MILLIKEN VALVE CO.
- VAL-MATIC

**RESTRICTIONS:**

- Use of this product is limited to pumping station valve vaults.



<p><b>D 2 – Check Valve- Resilient Seat/ Potable Water 2” Thru 30” (FLG X FLG):</b></p>	<p>Effective Date: <u>01-01-20</u>                  Revision #: <u>2</u></p>
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**SPECIFICATION:**

- Check valves shall meet or exceed the performance specifications of ANSI/AWWA C508 standards.
- Shall have resilient seat.
- Shall be manufactured from ductile iron per ASTM Standards A536 65-45-12.
- Shall be pressure rated for 250 psi (minimum) working pressure.
- Both ends shall be flanged, faced and drilled in accordance with ANSI B16.1, Class 125.
- All ferrous interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating in compliance with ANSI/AWWA C550.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- A mechanical indicator shall be provided to provide disc position.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

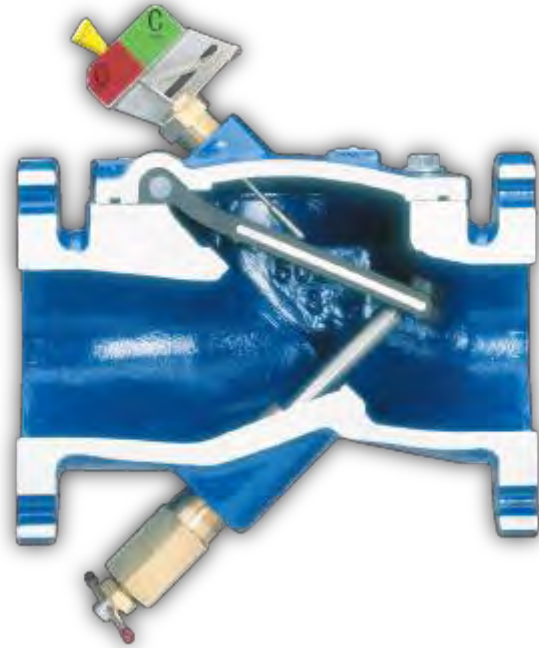
- Ductile iron, ASTM Standards A536 grade 65-45-12.

**Disc:**

- Ductile iron, encapsulated with:
  - EPDM (ethylene-propylene) rubber
  - Buna- N rubber

**Shaft:**

- Stainless steel.



**MANUFACTURER:**

- AMERICAN FLOW CONTROL
- DEZURIK-APCO
- VAL-MATIC VALVE & MFG. CORP.

**RESTRICTIONS:**

<b>D 3 – SWING CHECK VALVES - POTABLE WATER 2" THRU 16" (FLG X FLG):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

- Check valves shall meet or exceed the performance specifications of AWWA C508, swing check valves.
- Shall be manufactured from ductile iron per ASTM Standards A536 65-45-12.
- Shall be pressure rated for 175 psi (minimum) working pressure.
- Both ends shall be flanged, faced and drilled in accordance with ANSI B16.1, Class 125.
- All ferrous interior and exterior body and bonnet surfaces shall be coated with a fusion bonded epoxy coating in compliance with ANSI/AWWA C550.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.
- Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by \*(UL/FM).
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Ductile iron, ASTM Standards A536 grade 65 45-12.

**Disc:**

- Bronze with EPDM (ethylene-propylene) rubber facing and a stainless steel shaft.



**MANUFACTURER:**

- AMERICAN FLOW CONTROL
- DEZURIK-APCO
- GA INDUSTRIES
- KENNEDY VALVE
- M&H VALVE
- MUELLER

**RESTRICTIONS:**

<b>D 3.1 – SWING CHECK VALVES- SANITARY SEWER 4” THRU 16” (FLG X FLG):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

- Check valves shall meet or exceed the performance specifications of AWWA C508, swing check valves.
- Horizontal swing type with bolted bonnets.
- Shall be manufactured from ductile iron per ASTM Standards A536 65-45-12 (cast iron per ASTM Standards A126 Class B).
- Shall be pressure rated for 175 psi. (minimum) working pressure.
- Both ends shall be flanged, faced and drilled in accordance with ANSI B16.1, Class 125.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall be furnished with an outside lever and weight.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Ductile iron, ASTM Standards A536 grade 65 45-12.

**Disc:**

- Cast or ductile iron with bronze seat and a 316 stainless steel shaft.



**MANUFACTURER:**

- AMERICAN FLOW CONTROL
- DEZURIK-APCO
- GA INDUSTRIES
- KENNEDY VALVE
- M&H VALVE
- MUELLER

**RESTRICTIONS:**



<p><b>D 3.2 – SWING CHECK VALVES/ RESILIENT SEAT– SANITARY SEWER (3” THRU 12”) (FLG X FLG):</b></p>	<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
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**SPECIFICATION:**

- Check valves shall meet or exceed the performance specifications of AWWA C508, swing check valves.
- Shall be manufactured from ductile iron per ASTM Standards A536 65-45-12.
- Body and bonnet shall have fusion bonded epoxy coating on interior and exterior complying with AWWA C550.
- Shall be pressure rated for 175 psi (minimum) working pressure.
- Both ends shall be flanged, faced and drilled in accordance with ANSI B16.1, Class 125.
- Shall have a resilient seat that is drop tight, even at low pressure.
- Shall have no obstructions in the flow path for a 100% clear waterway.
- Valves supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Shall be furnished with an outside lever and spring.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**Body:**

- Ductile iron, ASTM Standards A536 grade 65-45-12.

**Disc:**

- Shall be a carbon steel core completely encapsulated with EPDM.

**Bonnet Bolts:**

- 316 stainless steel.

**Hinge and Hinge Pin:**

- 316 stainless steel, hinge on 10”-12” is ductile iron.

**O-Rings:**

- Acrylonitrile-butadiene rubber (NBR).

**DESIGN:**

- Shall be designed such that the disc, hinge, and bonnet can be removed as one assembly.
- Can be mounted vertically or horizontally.
- All internal exposed metal is stainless steel.




**MANUFACTURER:**

- AMERICAN AVK SERIES 41/ 42-43X

**RESTRICTIONS:**

<b>D 4 – COMBINATION AIR VALVES– STAINLESS STEEL/ SANITARY SEWER/ 2” thru 12” FORCE MAINS:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b></p> <ul style="list-style-type: none"> <li>• Combination air valves for sewage shall meet or exceed the performance specifications of AWWA C512-15.</li> <li>• Shall be specially designed to operate with liquids carrying solid particles such as sewage and effluent.</li> <li>• Shall release accumulated air from the system while the system is under pressure.</li> <li>• The valve must discharge air at high velocity during the filling of the system and admit air during its drainage.</li> <li>• The valve shall be a double or triple float design.</li> <li>• Shall be pressure rated for at least 75 psi.</li> <li>• Shall be test pressure rated for at least 1.5 times working pressure.</li> <li>• Threaded connection shall be National Pipe Thread (NPT).</li> <li>• Shall be equipped with a gauge or relief port.</li> <li>• Valves supplied must have ISO 9001 or later certification, or manufactured in the U.S.A.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>MATERIAL:</u></b></p> <p><b>Body:</b></p> <ul style="list-style-type: none"> <li>• Reinforced Nylon/316 Stainless Steel.</li> </ul> <p><b>Outer Metal Parts:</b></p> <ul style="list-style-type: none"> <li>• 304, 316 Stainless Steel and epoxy coated ductile iron.</li> </ul> <p><b>Inner Metal Parts:</b></p> <ul style="list-style-type: none"> <li>• 316 Stainless Steel.</li> </ul> <p><b>Floats:</b></p> <ul style="list-style-type: none"> <li>• Plastic materials/ Foamed Polypropylene or High Density Polyethylene.</li> </ul> <p><b>O-Rings &amp; Seals:</b></p> <ul style="list-style-type: none"> <li>• Nitrile Buna-N or EPDM (ethylene-propylene) rubber.</li> </ul>	<p><b><u>CONNECTIONS:</u></b></p> <p><b>Inlet:</b></p> <ul style="list-style-type: none"> <li>• 2” Standard Male Iron Pipe Threads (MNPT).</li> </ul> <p><b>Outlet:</b></p> <ul style="list-style-type: none"> <li>• Stainless Steel screen mesh &amp; cover.</li> <li>• Flushing connection.</li> </ul> <div style="text-align: center;">  </div>	
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• For force main sizes up and including twelve (12”) inch.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• ARI USA, INC.– MODEL D-020</li> <li>• GA INDUSTRICS</li> <li>• APCO VALVES</li> <li>• VAL-MATIC</li> </ul>	

<b>D 4.1 – COMBINATION AIR VALVES– STAINLESS STEEL/ SANITARY SEWER/ 12” AND LARGER FORCE MAINS:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b></p> <ul style="list-style-type: none"> <li>• Combination air valves for sewage shall meet or exceed the performance specifications of AWWA C512-15.</li> <li>• Shall be specially designed to operate with liquids carrying solid particles such as sewage and effluent.</li> <li>• Shall release accumulated air from the system while the system is under pressure.</li> <li>• The valve must discharge air at high velocity during the filling of the system and admit air during its drainage.</li> <li>• The valve shall be a double or triple float design.</li> <li>• Shall be pressure rated for at least 150 psi.</li> <li>• Shall be test pressure rated for at least 1.5 times working pressure.</li> <li>• Flange surface shall be faced and drilled in accordance with ANSI Class 125 B16.1.</li> <li>• Valves supplied must have ISO 9001 or later certification, or manufactured in the U.S.A.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>CONNECTIONS:</u></b></p> <p><b>Inlet:</b></p> <ul style="list-style-type: none"> <li>• 4” Flange for mains up to and including 24” mains.</li> <li>• 6” Flange for mains larger than 24”.</li> </ul> <p><b>Outlet:</b></p> <ul style="list-style-type: none"> <li>• Stainless Steel screen mesh &amp; cover.</li> <li>• Flushing connection.</li> </ul>	<p><b><u>MATERIAL:</u></b></p> <p><b>Body:</b></p> <ul style="list-style-type: none"> <li>• 316 Stainless Steel.</li> </ul> <p><b>Outer Metal Parts:</b></p> <ul style="list-style-type: none"> <li>• 316 Stainless Steel</li> </ul> <p><b>Inner Metal Parts:</b></p> <ul style="list-style-type: none"> <li>• 316 Stainless Steel.</li> </ul> <p><b>Floats:</b></p> <ul style="list-style-type: none"> <li>• Plastic materials/ Foamed Polypropylene, High Density Polyethylene or 316 Stainless Steel.</li> </ul> <p><b>O-Ring:</b></p> <ul style="list-style-type: none"> <li>• Nitrile Buna-N or EPDM (ethylene propylene) rubber.</li> </ul> <div style="text-align: center;">  </div>	
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• For force main sizes 12” and larger.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• ARI USA, INC.– Model D -020</li> </ul>	

<b>D 5 – AIR RELEASE VALVES (UL/FM)- POTABLE WATER:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Air release valves for potable water shall meet or exceed the performance specifications of:

- Shall be automatic float operated designed to release accumulated air from the piping system while the system is in operation and under pressure.
- AWWA C512.
- Shall be Underwriters Laboratories Listed (UL) and Factory Mutual Approved (FM) as noted by (UL/FM).
- Shall have a screened hood.
- The valve body shall be threaded with National Pipe Thread (NPT) inlets and outlets.
- Shall be pressure rated for at least 175 psi.
- Shall be test pressure rated for at least 1.5 times working pressure.
- Valves supplied must have ISO 9001 or later certification, or manufactured in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.

**CONNECTIONS:**

**Inlet:**

- 1” Standard Female Iron Pipe Threads (FNPT).

**RESTRICTIONS/ OPTIONAL USE:**

- UL/FM is required on valves installed on potable mains in sizes 12” and smaller.

**MATERIAL:**

**Body & Cover:**

- Cast iron or ductile iron conforming to ASTM Standards A126 or A536.

**Coating:**

- Fusion bonded epoxy.

**Outer trim:**

- Stainless Steel.

**Inner metal parts:**

- 316 Stainless Steel.

**Inner rubber parts:**

- Nitrile Buna-N, EPDM (ethylene propylene) or Viton rubber.



**MANUFACTURER:**

- VALVE MATIC MFG. CORP.– VM-15AH
- VALVE MATIC MFG. CORP.– VM-22H
- OPEN

**D 6 – AIR RELEASE VALVES (2”) - POTABLE WATER:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Air release valves for potable water shall meet or exceed the performance specifications of:

- Shall be automatic float operated designed to release accumulated air from the piping system while the system is in operation and under pressure.
- AWWA C512.
- Shall have a screened hood (not shown in detail).
- The valve body shall be threaded with National Pipe Thread (NPT) inlets and outlets.
- Shall be pressure rated for at least 150 psi.
- Shall be test pressure rated for at least 1.5 times working pressure.
- Valves supplied must have ISO 9001 or later certification, or manufactured in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.

**CONNECTIONS:**

**Inlet:**

- 2” Standard Female National Pipe Threads (FNPT).

**MATERIAL:**

**Body & Cover:**

- Cast iron or ductile iron conforming to ASTM Standards A126 or A536.

**Coating:**

- Exterior shall have universal alkyd primer.

**Outer Trim:**

- Stainless Steel.

**Inner Metal Parts:**

- 316 Stainless Steel.

**Inner Rubber Parts:**

- Nitrile Buna-N, EPDM (ethylene propylene) or Viton rubber.



**MANUFACTURER:**

- VALVEMATIC MFG. CORP – VM-45
- OPEN

**RESTRICTIONS/OPTIONAL USE:**

- Acceptable for use on potable main sizes over 12” only.

**D 7 – FULL FLANGE PRESSURE SENSOR:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Full flange sensors shall meet or exceed the performance specifications of:

- Protect and isolate pressure gauge.
- Full 360-deg pressure reading.
- Self-cleaning flex action, non-clogging.
- 2-1/2" diameter companion pressure gauge, ±1% accuracy, pressure range as indicated on drawings.
- Affidavit of compliance to this specification shall be available upon request.

**CONNECTIONS:**

- ANSI B16.5 Class 150 flanges, carbon steel or PVC

**MATERIAL:**

**Body:**

- Carbon steel or PVC.

**Lining:**

- Sleeve lining material recommended for raw sewage.

**Fill Fluid:**

- Ethylene glycol and water, vegetable oil, silicon oil.



**MANUFACTURER:**

- RED VALVE SERIES 40
- ONYX

**RESTRICTIONS/OPTIONAL USE:**

- Pressure gauge installations for valve vaults and meter vaults at wastewater pumping stations.



<b>D 8 – POST TYPE HYDRANTS:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Post type hydrants shall meet or exceed the performance specifications of:

- ANSI/AWWA C502.
- Post type dry barrel design.

**MATERIAL:**

**Hydrant Shoe/Elbow:**

- Cast iron, ASTM A0126 Class B

**Stand Pipe:**

- Ductile iron ASTM A-126

**Main Valve Rod:**

- Steel C1117 HFS

**Operating Nut:**

- Bronze alloy CDA 84400, ASTM B-584

**Lubricating Nut:**

- Brass

**INLET SIZE AND TYPE:**

- 2" mechanical joint.

**OUTLET SIZE AND TYPE:**

- 2-1/2" hose nozzle.



**RESTIRCTIONS:**

- Not for fire protection. For use only at pump station sites.

**MANUFACTURER:**

- MUELLER
- M&H
- KUPFERLE FOUNDRY COMPANY

**D 9 – REDUCED PRESSURE DETECTOR ASSEMBLY / 2 1/2” thru 10”**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Reduced Pressure Detector Assembly shall meet or exceed the performance specification of:

- AWWA C511-92
- Shall be installed on fire protection systems when connected to a public water supply.
- The unit shall be a complete assembly including UL listed and FM approved OSY shutoff valves.
- Shall be coated with approved AWWA epoxy coating.
- Assemblies supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Temperature Range: 33°F – 140°F
- Maximum Working Pressure: 175 psi
- Affidavit of compliance to this specification shall be available upon request.

**MATERIALS**

**Body:**

- Epoxy coated cast iron

**Discs:**

- Rubber

**Seat and Disc Holder:**

- Bronze

**Trim:**

- Stainless Steel

**SIZE**

- 2 1/2” – 10”




**MANUFACTURER:**

- WATTS – Model Series 909 RPDA
- OPEN

**RESTRICTIONS:**



<b>D 10 – DOUBLE CHECK DETECTOR ASSEMBLY / 3” thru 10”</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Reduced Pressure Detector Assembly shall meet or exceed the performance specification of:</p> <ul style="list-style-type: none"> <li>• AWWA C510</li> <li>• The assembly shall meet the basic requirements of ASSE 1048</li> <li>• Shall be installed on fire protection systems when connected to a public water supply.</li> <li>• The unit shall be a complete assembly including UL listed resilient seated OSY shutoff valves and test cocks</li> <li>• The auxiliary line shall consist of an approved backflow preventer and water meter.</li> <li>• Shall be coated with approved AWWA epoxy coating.</li> <li>• Assemblies supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Temperature Range: 33°F – 110°F continuous, 140°F intermittent</li> <li>• Maximum Working Pressure: 175 psi</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>MATERIALS</u></b> <b>Body:</b></p> <ul style="list-style-type: none"> <li>• Epoxy coated cast iron</li> </ul> <p><b>Discs:</b></p> <ul style="list-style-type: none"> <li>• Rubber</li> </ul> <p><b>Seat and Disc Holder:</b></p> <ul style="list-style-type: none"> <li>• Bronze</li> </ul> <p><b>Trim:</b></p> <ul style="list-style-type: none"> <li>• Stainless Steel</li> </ul> <p><b><u>SIZE</u></b></p> <ul style="list-style-type: none"> <li>• 3” – 10”</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• WATTS – Model Series 709 DCDA</li> <li>• OPEN</li> </ul>	



<p><b>Section E: Fire Hydrants</b></p>	<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
<p><a href="#">E 1 Fire Hydrants</a></p>	

<p><b>E 1 – FIRE HYDRANTS:</b></p>	<p>Effective Date: <u>01-01-20</u>                  Revision #: <u>2</u></p>
<p><b><u>SPECIFICATION/ MATERIAL:</u></b>                  All fire hydrants shall fully comply with all provisions of American Water Works Association C-502 (Dry Barrel Fire Hydrants) latest revision thereof, Factory Mutual Approved (FM) and Underwriter Laboratory Listed (UL) as noted by (UL/FM) (AWWA, U.L. and F.M. COLOPHONS MUST BE CAST IN UPPER BARREL OF EACH HYDRANT) and meet the following specific provisions:</p> <ul style="list-style-type: none"> <li>• It will be compression type, opening counterclockwise, against the pressure and closing with the pressure.</li> <li>• Drain outlets shall be provided.</li> <li>• Hydrant bonnet assembly shall be provided with a grease or oil reservoir and lubrication system that automatically circulates lubricant to all operating stem threads and bearing surfaces each time the hydrant is operated. The system shall be completely sealed from the waterway and from external contaminants.</li> <li>• The grease or oil used for lubrication shall be nontoxic and safe for use in potable water systems.</li> <li>• All hydrants will be of the traffic “breakaway” type with safety stem coupling and breakable flange that permits full 360° rotation of the nozzle section. Cut down bolts are not acceptable for this requirement.</li> <li>• Main valve opening of the hydrant will not be less than 5-1/4” and open against the pressure.</li> <li>• Hydrant nozzles will consist of two (2) hose nozzles and one (1) pumper nozzle. Primary outlet shall be a 5” Storz quick connection. Sided outlets shall have American National standard fire hose coupling threads.</li> <li>• All nozzles shall be field replaceable with non corrosive locking devices.</li> <li>• Caulked nozzles are prohibited.</li> <li>• Nozzle chains shall be provided.</li> <li>• An all bronze hydrant valve seat ring shall thread directly into an all bronze ring and shall be located between the lower hydrant barrel and base securely retained in this position.</li> <li>• Upper valve plate must be B62 bronze, or epoxy coated, if used.</li> </ul>	

**E 1 – FIRE HYDRANTS (CONTINUED):**

**SPECIFICATION/MATERIAL (CONT.)**

- The hydrant will be designed with an anti-friction bearing, so located that it will reduce the torque required to operate the hydrant.
- All internal stem pins or bolts and nuts shall be stainless steel.
- The safety stem coupling shall be of either Cast Iron, Bronze, or Stainless Steel.
- The operating stem, safety stem coupling and main valve assembly shall be capable of withstanding an application of 200 ft-lbs. of torque against either the full open or closed position with no damage to components. Downward stem travel shall be limited by a travel stop location in the upper housing of the hydrant or a stop in the shoe assembly.
- Operating nut and nozzle cap wrench nuts shall conform to existing specifications for this utility.
- The opening between the operating nut and dome shall have a weather shield or seal.
- The ferrous waterway of the hydrant’s shoe must be epoxy coated.
- The shoe assembly must be designed to allow all of the MJ gland tee bolts to be inserted from the shoe body side.
- Centerline of pumper connection shall be a minimum of eighteen-inches (18”) above ground line.
- Ground line shall be three-inches (3”) or less below break flange.
- Main rubber valve shall be EPDM (ethylene propylene) rubber.
- Affidavit of compliance to this specification shall be available upon request.
- 316 stainless steel fasteners.

**BURY LENGTH:**

- Fire hydrant length, also known as the bury length, shall be as shown of CFPWA Standard Details.

**COLOR:**

- Hydrant final color shall be red using a factory applied powder coating.

**INLET SIZE AND TYPE:**

- Inlet shall be six-inch (6”) Mechanical Joint (MJ).

**ADDITIONAL REQUIREMENTS:**

- Only factory authorized repair parts and extensions will be acceptable.

**MANUFACTURER:**

- AMERICAN AVK NOSTALGIC 2780 SERIES
- AMERICAN FLOW CONTROL B-84-B
- AMERICAN FLOW CONTROL WATEROUS PACER
- CLOW MEDALLION
- KENNEDY GUARDIAN K81-D
- MUELLER SUPER CENTURION A-423
- US PIPE METROPOLITAN M-94

**RESTRICTIONS:**



**Section F: Service Saddles and Tapping Devices**Effective Date: 01-01-20  
Revision #: 2

[F 1 Service Saddles/ Hinged Type for 2" PVC](#)

[F 1.1 Service Saddles/ Brass Alloy/ Stainless Steel Straps for Cast, Ductile & PVC Pipe](#)

[F 1.2 Service Saddles/ Ductile Iron/ Stainless Steel Straps for Cast, Ductile & PVC Pipe](#)

[F 2 Tap Sleeves 4" Thru 24", Flange Connection \(Fabricated Stainless Steel\)](#)

[F 2.1 Tap Sleeves 4" Thru 12", Mechanical Joint Connection \(Fabricated Stainless Steel\)](#)

[F 3 Sewer Service Saddles/ Ductile Iron/ Stainless Steel Straps/Non-Pressure](#)

<b>F 1 – SERVICE SADDLE, BRASS/ ALLOY/ HINGED TYPE/ 2” PVC:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Brass alloy service saddles shall meet or exceed the performance specifications of:

- ASTM Standards B62 (85-5-5-5) brass.
- ASTM Standards D2000 gaskets seals.
- Strap shall be a single hinged strap.
- Strap shall have a curvature accurately formed to meet the diameter of the pipe.
- Gasket shall be securely glued or imbedded in the body of the clamp to ensure a positive seal against the pipe.
- NSF Standards 61.

**MATERIAL:**

**Body:**

- Brass per ASTM Standards B62

**Straps:**

- Brass per ASTM Standards B62

**Bolts & Nuts:**

- Brass per ASTM Standards B62

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene- (NBR)).
- Viton; Fluorel (FKM)

**Coating:**

- Brass: None

**DESIGN:**

- For 2” IPS PVC pipe.

**OUTLETS:**

- 1” shall be female AWWA CC taper female threads.
- 2” shall be female iron pipe threads.

**RESTRICTIONS:**


- Hinged saddles are not acceptable



**MANUFACTURER:**

- A.Y. MCDONALD MODEL- 3891
- FORD MODEL- S70
- MUELLER MODEL- S13420



<b>F 1.1 – SERVICE SADDLES / BRASS ALLOY / STAINLESS STEEL STRAPS FOR CAST IRON, DUCTILE IRON &amp; PVC PIPE:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b></p> <ul style="list-style-type: none"> <li>• Brass alloy service saddles shall meet or exceed the performance specifications of:</li> <li>• ASTM Standards B62 (85-5-5-5) brass.</li> <li>• ASTM Standards D2000 gaskets seals.</li> <li>• Single or multiple stainless steel straps three-inches wide or more. Single strap preferred.</li> <li>• Welds shall be fully passivated for corrosion resistance.</li> <li>• Straps shall have a curvature accurately formed to lubricant treated nuts to prevent galling.</li> <li>• Gasket shall be securely glued or imbedded in the body of the clamp to ensure a positive seal against the pipe.</li> <li>• NSF Standards 61.</li> </ul> <p><b><u>MATERIAL:</u></b></p> <p><b>Body:</b></p> <ul style="list-style-type: none"> <li>• Brass per ASTM Standards B62</li> </ul> <p><b>Straps:</b></p> <ul style="list-style-type: none"> <li>• Stainless steel, 18-8 type 304</li> </ul> <p><b>Nuts, Bolts &amp; Washers:</b></p> <ul style="list-style-type: none"> <li>• Stainless steel, 18-8 type 316</li> </ul> <p><b>Gasket:</b></p> <ul style="list-style-type: none"> <li>• EPDM (ethylene propylene)</li> <li>• Nitrile Buna-N (Acrylonitrile butadiene (NBR)).</li> <li>• Viton; Fluorel (FKM)</li> </ul> <p><b>Coating:</b></p> <ul style="list-style-type: none"> <li>• Brass: None</li> </ul> <p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>• For cast iron, ductile iron and PVC pipe.</li> </ul> <p><b><u>OUTLETS:</u></b></p> <ul style="list-style-type: none"> <li>• 1" shall be female AWWA CC taper female threads.</li> <li>• 2" shall be female iron pipe threads.</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Shall be used for connections to 12" mains or smaller.</li> <li>• Hinged saddles are not acceptable</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• A.Y. MCDONALD– 3845, 3846 &amp; 3855, 3856 SERIES</li> <li>• FORD– 202BS STYLE</li> <li>• MUELLER– BR2S SERIES</li> <li>• POWER SEAL–3409 SERIES</li> <li>• ROMAC– 202BS SERIES</li> <li>• SMITH BLAIR– 325, 393 SERIES</li> </ul>	

<p><b>F 1.2 – SERVICE SADDLES/ DUCTILE IRON/ STAINLESS STEEL STRAPS FOR CAST IRON, DUCTILE IRON &amp; PVC PIPE:</b></p>	<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
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**SPECIFICATION:**  
 Ductile iron service saddles shall meet or exceed the performance specifications of:

- ASTM Standards A536 ductile iron.
- ASTM Standards D2000 gaskets seals.
- Single or multiple stainless steel straps three-inches wide or more. Single strap preferred.
- Welds shall be fully passivated for corrosion resistance.
- Straps shall have a curvature accurately formed to meet the diameter of the pipe.
- Fusion nylon or fusion epoxy coating, minimum 12 mils thick.
- Lubricant treated nuts to prevent galling.
- Gasket shall be securely glued or imbedded in the body of the clamp to ensure a positive seal against the pipe.
- NSF Standards 61.

**MATERIAL:**  
**Body:**

- Ductile iron per ASTM Standards A536

**Straps:**

- Stainless steel, 18-8 type 304

**Nuts, Bolts & Washers:**

- Stainless steel, 18-8 type 316

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**Coating:**

- Ductile iron: fusion epoxy or nylon.

**DESIGN:**

- For ductile iron, cast iron, and PVC pipe.

**OUTLETS:**

- 1" shall be female AWWA CC taper female threads.
- 2" shall be female iron pipe threads.



**MANUFACTURER:**

- A.Y. MCDONALD- 4845A, 4846A, 4855A, 4856A SERIES
- CASCADE– CNS2 STYLE
- DRESSER-291 SERIES per spec.
- FORD– FC202 STYLE
- JCM– 406 SERIES
- MUELLER– DR2S SERIES
- POWER SEAL–3417DI, 3417SW
- ROMAC– 202NS SERIES
- SMITH BLAIR– 397, 317 SERIES

**RESTRICTIONS:**

- Shall be used for connections to 12" mains or smaller.
- Hinged saddles are not acceptable

<b>F 2 – TAP SLEEVES 4” THRU 24” FLANGE CONNECTION/ FABRICATED STAINLESS STEEL:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Service saddles shall meet or exceed the performance specifications of:

- ASTM Standards D2000 gaskets seals.
- AWWA C115 and C223
- Outlet branch O-ring seal type gasket.
- ASTM Standards A240, 18-8 type 304 stainless steel.
- Welds shall be fully passivated for corrosion resistance.
- Body shall have a curvature accurately formed to meet the diameter of the pipe.
- Lubricant treated nuts to prevent galling.
- Gasket shall be securely glued or imbedded in the body of the clamp to ensure a positive seal against the pipe.
- NSF Standards 61.

**MATERIAL:**

**Body:**

- Stainless steel, 18-8 type 304.

**Flange:**

- Stainless steel, 18-8 type 304.

**Nuts, Bolts & Washers:**

- Stainless steel, type 316.

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**DESIGN:**

- For ductile iron, cast iron and PVC pipe.

**CONNECTION:**

- Flange shall conform to AWWA C228 Class SD and recessed for tapping valve (MSS-SP60).

**ADDITIONAL REQUIREMENTS:**

- This product is for connection of branch lines to existing in-service pipelines.



**MANUFACTURER:**

- FORD METER BOX STYLE FTSS
- JCM 432 SERIES
- POWER SEAL 3490AS SERIES
- ROMAC SST III SERIES

**RESTRICTIONS:**

<b>F 2.1 – TAP SLEEVES 4” THRU 12”, MECHANICAL JOINT CONNECTION/ FABRICATED STAINLESS STEEL:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Service saddles shall meet or exceed the performance specifications of:

- AWWA C110 mechanical joint dimensions.
- ASTM Standards D2000 gaskets seals.
- Outlet branch O-ring seal type gasket.
- 18-8 type 304 stainless steel.
- Welds shall be fully passivated for corrosion resistance.
- Body shall have a curvature accurately formed to meet the diameter of the pipe.
- Lubricant treated nuts to prevent galling.
- Gasket shall be securely glued or imbedded in the body of the clamp to ensure a positive seal against the pipe.
- NSF Standards 61.

**MATERIAL:**

**Body:**

- Stainless steel, 18-8 type 304.

**Flange:**

- Stainless steel, 18-8 type 304.

**Nuts, Bolts & Washers:**

- Stainless steel, type 316

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**DESIGN:**

- For ductile iron, cast iron and PVC pipe.

**CONNECTION:**

- Mechanical Joint (MJ).

**RESTRICTIONS:**

**ADDITIONAL REQUIREMENTS:**

- This product is for connection of branch lines to existing in-service pipelines.



**MANUFACTURER:**

- FORD METER BOX STYLE FTSS MJ
- JCM 432 SERIES MJ
- POWER SEAL 3490AS SERIES MJ
- ROMAC SST III SERIES MJ

<b>F 3 – SEWER SERVICE SADDLES/ DUCTILE IRON/ STAINLESS STEEL STRAPS/ NON-PRESSURE:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b>                  Ductile iron service saddles shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• ASTM Standards A536 ductile iron.</li> <li>• ASTM Standards D2000 gaskets seals.</li> <li>• Type 304 stainless steel.</li> <li>• Strap shall be a single strap three-inches or more wide.</li> <li>• Welds shall be fully passivated for corrosion resistance.</li> <li>• Straps shall have sufficient length to fit a wide range of pipe diameters.</li> <li>• Fusion nylon or fusion epoxy coating, minimum 12 mils thick or shop coat paint finish.</li> <li>• Lubricant treated nuts to prevent galling.</li> <li>• Gasket shall be securely glued or imbedded in the body of the clamp or inserted in the body of the clamp to ensure a positive seal against the pipe.</li> </ul> <p><b><u>MATERIAL:</u></b>  <b>Body:</b></p> <ul style="list-style-type: none"> <li>• Ductile iron per ASTM Standards A536 Grade 65-45-12 or Cast Iron per ASTM A126.</li> </ul> <p><b>Straps:</b></p> <ul style="list-style-type: none"> <li>• Stainless steel, ASTM A 240 type 304</li> </ul> <p><b>Bolts, Nuts &amp; Washers:</b></p> <ul style="list-style-type: none"> <li>• Stainless steel, ASTM A193, A194, A240 type 304</li> </ul> <p><b>Gasket:</b></p> <ul style="list-style-type: none"> <li>• SBR (Styrene Butadiene).</li> <li>• Polyisoprene</li> <li>• EPDM (ethylene propylene).</li> <li>• Nitrile Buna-N (Acrylonitrile butadiene (NBR)).</li> <li>• Viton; Fluorel (FKM).</li> </ul> <p><b>Coating:</b></p> <ul style="list-style-type: none"> <li>• Ductile iron= fusion epoxy, nylon or shop coat paint finish.</li> </ul>	<p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>• For ductile iron, cast iron, and poly vinyl chloride (PVC) pipe.</li> </ul> <p><b><u>OUTLETS:</u></b></p> <ul style="list-style-type: none"> <li>• 4" and 6"</li> </ul> <div style="text-align: center;">   </div>	
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Hinged saddles are not acceptable.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• ROMAC– STYLE “CB” SEWER SADDLE</li> <li>• GENECO SEALTITE SEWER PIPE SADDLE</li> <li>• FORD METER BOX FSS SEWER SADDLE</li> </ul>	



**Section G: Brass Service Materials**Effective Date: 01-01-20  
Revision #: 2[G 1 Inline Valves](#)[G 2 Straight Couplings](#)[G 3 Meter Setters \(5/8" X 3/4" Meter\)](#)[G 3.1 Meter Setters \(1" Meter\)](#)[G 3.2 Meter Setters \(1 1/2" & 2" Meter\)](#)[G 4 Dual Service U-Branch \(5/8" X 3/4" Meter\)](#)[G 4.1 Dual Service U-Branch \(1" Meter\)](#)[G 5 Compound Meters](#)[G 6 High Resolution Encoder](#)[G 7 Migratable Endpoint](#)

**G 1 – INLINE VALVES:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

Compression type brass fittings & accessories with external gripping devices shall meet or exceed the performance specifications of:

- Manufactured in compliance with ANSI/AWWA C800 (latest revision).
- Certified to NSF/ANSI 61 and NSF/ANSI 372
- Brass components in contact with potable water conform to ASTM B584, UNS C89833 (latest revision) and identified with "NL".
- Connection stop shall have compression nut and gasket service line connections.
- Size of corporation stop shall match that of service line.
- Stainless steel insert stiffeners

**Set Screw:**

- 316 Stainless Steel

**Gasket:**

- EPDM

**Connections:**

- CTS x FIP



**MANUFACTURER:**

- McDonald: 76102 22 (1")
- Ford: B-41-44-4W-NL (1")

**RESTRICTIONS:**



**G 2 – STRAIGHT COUPLINGS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

Meter couplings shall meet or exceed the performance specifications of:

- Brass components in contact with potable water conform to ASTM B584, UNS C89833 (latest revision) and identified with “NL”.
- Manufactured in compliance with ANSI/AWWA C800 (latest revision).
- Certified to NSF/ANSI 61 and NSF/ANSI 372
- Stainless steel insert stiffeners.

**Set Screw:**

- 316 Stainless Steel

**Gasket:**

- EPDM

**Connections:**

- CTS x MIP



**MANUFACTURER:**

- McDonald: 74753-22 (3/4" X 1") and (1" X 1")
- Ford: C-84-34-NL (3/4" X 1")
- Ford: C-84-77-NL (2")
- Ford: C-84-44-NL (1" X 1")

**RESTRICTIONS:**

**G 3 – METER SETTERS (5/8" X 3/4" METER):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Meter setters shall meet or exceed the performance specifications of:

- Castings shall be made of ASTM Standards 862 (85-5-5-5) brass.
- Applicable parts of AWWA C800.

**MATERIAL:**

**Body:**

- ASTM Standards B-62 Brass.

**Riser:**

- Copper.

**Seal & O-rings:**

- EPDM rubber.

**Trim:**

- Brass.

**Solder:**

- Lead-free.

**DESIGN:**

- Ball type curb stop valve design.
- Valve shall have padlock wings.
- Shall have swivel meter saddle nut connections for 5/8" X 3/4" water meters

**CONNECTIONS:**

- Both top inlet and outlet sides shall be meter saddle nut.
- Single Service: CTS X CTS
- Dual Service: FPT X CTS

**SIZES:**

- Meter size: Five-eighths X three-quarter inch (5/8" x 3/4").
- Setter height: Seven inch (7").

**INCLUDED AND DELIVERED WITH SETTERS:**

- Two (1/8") thick EPDM rubber meter gaskets.

**RESTRICTIONS:**



**MANUFACTURER:**

**Single Meter:**

- McDonald: 722-207 WW 22 44
- Ford: VBB72-7W-44-44-NL

**Dual Meter:**

- McDonald: 725-207-WW-D2-33
- Ford: VBB72-7W-14-33-NL

**G 3.1 – METER SETTERS (1" METER):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Meter setters shall meet or exceed the performance specifications of:

- Castings shall be made of ASTM Standards 862 (85-5-5-5) brass.
- Applicable parts of AWWA C800.

**MATERIAL:**

**Body:**

- ASTM Standards B-62 Brass.

**Riser:**

- Copper.

**Seal & O-rings:**

- EPDM rubber.

**Trim:**

- Brass.

**Solder:**

- Lead-free.

**DESIGN:**

- Ball type curb stop valve design.
- Valve shall have padlock wings.
- Shall have swivel meter saddle nut connections for 1" water meters.

**CONNECTIONS:**

- Both bottom inlet and outlet sides shall be CTS.
- Both top inlet and outlet sides shall be meter saddle nut.

**SIZES:**

- Meter size: One inch (1").
- Setter height: Seven inch (7").

**INCLUDED AND DELIVERED WITH SETTERS:**

- Two (1/8") thick EPDM rubber meter gaskets.



**MANUFACTURER:**

**Single Service:**

- McDonald: 722-410 WW 22 44
- Ford: VBB74-10W-44-44-NL

**Dual Service**

- McDonald: 725-410WW-D2-44
- Ford: VBB74-10W-14-44-NL

**RESTRICTIONS:**

**G 3.2 – METER SETTERS (1 1/2" & 2" METER):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Meter setters shall meet or exceed the performance specifications of:

- Castings shall be made of ASTM Standards 862 (85-5-5-5) brass.
- Applicable parts of AWWA C800.

**MATERIAL:**

**Body:**

- ASTM Standards B-62 Brass.

**Riser:**

- Copper.

**Seal & O-rings:**

- EPDM rubber.

**Trim:**

- Brass.

**Solder:**

- Lead-free.

**DESIGN:**

- Ball type curb stop valve design.
- Valve shall have padlock wings.
- Shall have swivel meter saddle nut connections for 1 1/2" and 2" water meters.

**CONNECTIONS:**

- Both bottom inlet and outlet sides shall be CTS.
- Both top inlet and outlet sides shall be meter saddle nut.

**SIZES:**

- 1-1/2" and 2" water meters.

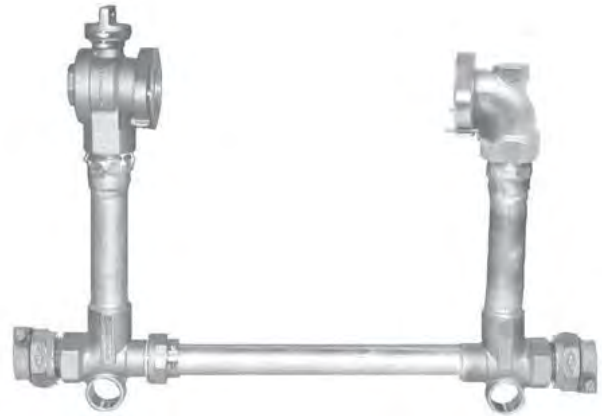
**INCLUDED AND DELIVERED WITH SETTERS:**

- Two (1/8") thick EPDM rubber meter gaskets.
- Two male thread nipples by compression (2")

**RESTRICTIONS:**

Use of this product is limited to:

- Single Service Meter



**MANUFACTURER:**

- McDonald: 720-R-612 WWFF 665 (1-1/2")
- McDonald: 722-R-712 WW 22 77 (2")
- Ford: VBB76-12-HB-44-77-NL (1-1/2")
- Ford: VBB77-15-HB-44-77-NL (2")

<b>G 4 – Dual Service U-Branch (5/8" X 3/4" METER):</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION/MATERIAL:</u></b> U-Branch fittings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Brass components in contact with potable water conform to ASTM B584, UNS C89833 (latest revision) and identified with "NL"</li> <li>• Manufactured in compliance with ANSI/AWWA C800 (latest revision)</li> <li>• Certified to NSF/ANSI 61 and NSF/ANSI 372</li> </ul> <p><b><u>CONNECTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• 1" CTS X 3/4" MNPT.</li> </ul> <p><b><u>DESIGN:</u></b></p> <ul style="list-style-type: none"> <li>• One (1") inch tailpiece must be machined inside and outside.</li> </ul> <p><b><u>INCLUDE:</u></b></p> <ul style="list-style-type: none"> <li>• One tail piece</li> <li>• One meter nut</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b> Use of this product is limited to:</p> <ul style="list-style-type: none"> <li>• 5/8" x 3/4" Dual Meter</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• McDonald: 708 U2M</li> <li>• Ford: U48-43-NL</li> </ul>	

**G 4.1 – Dual Service U-Branch (1" METER):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

U-Branch fittings shall meet or exceed the performance specifications of:

- Brass components in contact with potable water conform to ASTM B584, UNS C89833 (latest revision) and identified with "NL"
- Manufactured in compliance with ANSI/AWWA C800 (latest revision)
- Certified to NSF/ANSI 61 and NSF/ANSI 372

**CONNECTIONS:**

- 2" CTS X 1" MNPT.

**DESIGN:**

- One (1") inch tailpiece must be machined inside and outside.

**INCLUDE:**

- One tail piece
- One meter nut



**MANUFACTURER:**

- McDonald: 708 U2M
- Ford: U48-74-AWT-NL

**RESTRICTIONS:**

Use of this product is limited to:

- 1" Dual Meter

**G 5 – Compound Meters (3”, 4” and 6”):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Large meters shall meet or exceed the following performance specifications:

- Lead-free bronze alloy
- AWWA Standard C700
- NSF/ANSI Standards 61 and 372
- 316 stainless steel hardware
- EPDM gasket

**SIZE:**

Compound meters and strainers shall conform to the following lay lengths:

- 3” Compound meter with strainer – 24”
- 4” Compound meter with strainer – 29”
- 6” Compound meter with strainer – 33”

**LOW FLOW REGISTRATION:**

- 3” - .25 gpm
- 4” - .375 gpm
- 6” - .375 gpm

**DESIGN:**

- Meters and encoders must be compatible with Badger Meter AMR/AMI systems
- TORX tamper resistant seal screw

**INCLUDE:**

- Test plug
- Bronze Plate Strainer



**MANUFACTURER:**

- Badger Meter

**RESTRICTIONS:**

**G 6 – High Resolution Encoder:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

High resolution encoders shall meet or exceed the following performance specifications:

- Provide connectivity with Badger Meter ORION AMR/AMI endpoints.
- Eight-dial resolution to AMR/AMI endpoints.
- Eight-dial mechanical odometer wheel stack.
- Thermoplastic shroud assembly.
- Signal Type: 3-wire synchronous for AMR/AMI solutions (red=clock/power, black=ground, green=data)
- Unit of Measure shall be gallons

**DESIGN:**

**INCLUDE:**

- 25' pre-sized wire harness.
- Factory potted with Nicor in-line connector allowing connectivity to an endpoint without need for a field splice.

**OPERATING TEMPERATURE:**

- -40°F – 140°F



**MANUFACTURER:**

- Badger Meter

**RESTRICTIONS:**

- Shall be installed with compound meters



**G 7 – Migratable Endpoint:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Migratable endpoints shall meet or exceed the following performance specifications:

- 90 days of hourly historical interval meter data within the nonvolatile memory.
- Compatibility with High Resolution Encoder (HRE)
- Two-way communication

**INCLUDE:**

- Factory potted with Nicor In-line connector



**MANUFACTURER:**

- Badger Meter

**RESTRICTIONS:**

- Shall be installed with compound meters.



**Section H: Repair Sleeves, Couplings, Clamps & Non-Pressure Adapters**Effective Date: 01-01-20  
Revision #: 2

[H 1 Pipe Adapters, Non-Pressure](#)

[H 1.2 Pipe Adapters, Concrete Manhole Connection Boots:](#)

[H 2 Repair Clamps/ Ductile Iron Lugs \(Pipe Savers\)](#)

[H 3 Repair Clamps/ All Stainless Steel \(Pipe Savers\)](#)

[H 4 Full Seal Clamps](#)

[H 5 Bell Joint Leak Clamp](#)

[H 6 Repair Coupling/ Restrained/ DI, CI, PVC, & HDPE \(4" thru 12"\)](#)

[H 6.1 Repair Coupling/ Non-Restrained/ Transition \(2" thru 12"\)](#)

**H 1 – PIPE ADAPTERS, NON-PRESSURE:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

Non-pressure pipe adapters shall meet or exceed the performance specifications proscribed in:

- ASTM Standards D 5926 standard specification for Poly Vinyl Chloride (PVC) or manufactured with synthetic rubbers and ASTM Standards C 425 standard specification for watertight compression sealed joints of vitrified clay pipe and ASTM Standards C1173 standard specification for flexible transition couplings for underground piping systems.
- The connector shall be molded or extruded and vulcanized from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outline in ASTM C 5926.
- The material shall resistant to ozone, weathering, aging, and chemicals, including acids, alkalis, animal and vegetable fats, oils and petroleum products.
- Bands and screw assembly shall be manufactured from totally non-magnetic series 300 stainless steel.
- The size and application colophons must be embossed on each adapter.



**MANUFACTURER:**

- FERNCO INC.
- INDIANA SEAL-GPK
- MISSION RUBBER

**RESTRICTIONS:**

- For repairs and connections to existing vitrified clay pipe (VCP) facilities.
- For repairs and connections to other pipe materials for resistance to heavy earth loads and improved alignment use.

**H 1.2 – PIPE ADAPTERS, CONCRETE MANHOLE CONNECTION BOOTS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Concrete manhole pipe adapters shall meet or exceed the performance specifications in:

- ASTM Standards C 923, Resilient connectors between reinforced concrete manhole structures, pipes and laterals.
- Manhole adapters shall create a watertight flexible seal around pipes entering sanitary manhole walls.
- The material shall resistant to ozone, weathering, aging, and chemicals, including acids, alkalis, animal and vegetable fats, oils and petroleum products.
- Shall be made of elastomeric Poly Vinyl Chloride (PVC), ethylene propylene (EPDM) or polyisoprene rubber.
- The size and application colophons must be cast on each adapter.
- Bands and screw assembly shall be manufactured from totally non-magnetic series 300 stainless steel.

**REQUIREMENT:**

- Shall be used for connections to existing and new pre-cast manhole and structures.



**MANUFACTURER:**

- A-Lok Products
- Kor-N-Seal (NPS)
- OPEN

**RESTRICTIONS:**

**H 2 – REPAIR CLAMPS/ DUCTILE IRON LUGS (PIPE SAVERS):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Leak repair clamps shall meet or exceed the performance specifications of:

- ASTM Standards A536 ductile iron.
- 18-8 type 304 stainless steel.
- Gasket shall be securely glued or imbedded in the band of the clamp to ensure a positive seal against the pipe.
- Gaskets shall have ribbed surface.

**MATERIAL:**

**Lugs:**

- Ductile iron per ASTM Standards A536

**Band:**

- Stainless steel, 18-8 type 304.

**Bolts, Nuts & Washers:**

- 316 stainless steel.

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**Coating:**

- Ductile iron: shop coat.
- Stainless steel: none.

**DESIGN:**

- For patching holes in iron pipe size O.D. pipe.

**WIDTH OF CLAMP/ NUMBER OF BOLTS:**

- 3": One (1) bolt
- 6": Two (2) bolts

**RESTRICTIONS:**

- For repairs to existing, in-service pipelines by CFPUA personnel only.



**MANUFACTURER:**

- CASCADE CFC SERIES
- DRESSER STYLE 118
- FORD FSC SERIES
- JCM 110 SERIES
- MUELLER 212 SERIES
- TOTAL PIPING SOLUTIONS 4100 SERIES
- POWER SEAL 3151 SERIES
- ROMAC SC SERIES
- SMITH-BLAIR 245 SERIES

<b>H 3 – REPAIR CLAMPS/ ALL STAINLESS STEEL (PIPE SAVERS):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Leak repair clamps shall meet or exceed the Performance specifications of:

- 18-8 type 304 stainless steel.
- Type 304 cast stainless steel per ASTM Standards A743.
- Gasket shall be securely glued or imbedded in the band of the clamp to ensure a positive seal against the pipe.
- Lubricant treated nuts to prevent galling.
- Gaskets shall have ribbed surface.

**MATERIAL:**

**Lugs:**

- Type 304 cast stainless steel.

**Band:**

- Stainless steel, 18-8 type 304.

**Bolts, Nuts & Washers:**

- 316 stainless steel with lubricant treated nuts to prevent galling.

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**Coating:**

- Stainless steel: none.

**DESIGN:**

- For patching holes in iron pipe size O.D. pipe.
- Only cast lug design will be accepted.

**WIDTH OF CLAMP/ NUMBER OF BOLTS**

- 3": One (1) bolt
- 6": Two (2) bolts



**MANUFACTURER:**

- FORD FLSC
- SMITH-BLAIR 248
- ROMAC SCS

**RESTRICTIONS:**

- For repairs to existing, in-service pipelines by CFPUA personnel only.

**H 4 – FULL SEAL CLAMPS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Full circle leak repair clamps shall meet or exceed the performance specifications of:

- ASTM Standards A536 ductile iron.
- 18-8 type 304 stainless steel.
- Gasket shall be securely glued or imbedded in the band of the clamp to ensure a positive seal against the pipe.
- Gaskets shall have ribbed surface.

**MATERIAL:**

**Lugs:**

- Ductile iron per ASTM Standards A536

**Band:**

- Stainless steel, 18-8 type 304.

**Bolts, Nuts & Washers:**

- Low alloy steel per AWWA C 111.

**Gasket:**

- EPDM (ethylene propylene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**Coating:**

- Ductile iron: shop coat.
- Stainless steel: none.

**DESIGN:**

- For patching full circle holes in cast iron pipe size O.D. pipe.

**ADDITIONAL REQUIREMENTS:**

- Spring washers may be required for use on HDPE pipe (consult manufactures documentation).

**RESTRICTIONS:**

- For repairs to existing, in-service pipelines only.



**MANUFACTURER:**

- CASCADE CDR1
- DRESSER STYLE 360
- FORD F1 SERIES
- JCM 101 SERIES
- MUELLER 500 SERIES
- POWER SEAL 3121 SERIES
- ROMAC CL1 SERIES
- SMITH-BLAIR 226 SERIES



**H 5 – BELL JOINT LEAK CLAMP:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Leak repair clamps shall meet or exceed the Performance specifications of:

- ASTM Standards A536 ductile iron.
- Low alloy steel per AWWA C111.
- ASTM Standards D2000 gasket seals.

**MATERIAL:**

**Bell and Spigot Rings:**

- Ductile iron per ASTM Standards A536.

**Bolts, Nuts & Washers:**

- 316 stainless steel.

**Gasket:**

- EPDM (ethylene propylene).
- SBR (styrene butadiene)
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM)

**Coating:**

- Ductile iron: fusion bonded epoxy.

**DESIGN:**

- For leak repairs in bell joints on cast iron, ductile iron and C-900 PVC pipe.



• **MANUFACTURER:**

- FORD FBC SERIES
- MUELLER PIPE JOINT REPAIR CLAMP
- POWER SEAL 3232 SERIES
- ROMAC STYLE 516

**RESTRICTIONS:**

- For repairs to existing, in-service pipelines only.

<b>H 6 – REPAIR COUPLING/ RESTRAINED/ DI, CI, PVC, &amp; HDPE, (4” THRU 12”):</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Restraining repair sleeves or couplings shall meet or exceed the performance specifications of:

- Shall connect and restrain two plain end pipes of the same or dissimilar materials.
- Shall provide axial restraint by use of multiple gripping wedges incorporated into the follower glands coupled together with threaded rods.
- ASTM Standards A536 ductile iron.
- Low alloy steel per AWWA C111 (ANSI - A21.11) or latest revision thereof.
- ASTM Standards D2000 gasket seals.
- Shall possess a minimum rating of twice (2:1) the pressure rating of the pipe.
- Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.

**MATERIAL:**

**End Ring & Sleeve Body:**

- Ductile iron per ASTM Standards A536, minimum 65-45-12.

**Bolts, Nuts & Rods:**

- Low alloy steel per ANSI/ AWWA C111/ A21.11.

**Gasket:**

- EPDM (ethylene propylene).
- SBR (styrene butadiene).
- Nitrile Buna-N (Acrylonitrile butadiene (NBR)).
- Viton; Fluorel (FKM).

**Coating:**

- Coupling Body: fusion bonded epoxy.

**APPLICATION:**

- For leak repairs to join two plain end pipes of the same or dissimilar material.
- For use on cast iron, ductile iron, HDPE, and C-900 PVC pipe.

**RESTRICTIONS:**

- For repairs to existing, in-service pipelines only.
- Insert stiffener is required on HDPE pipe.



**MANUFACTURER:**

- EBBA IRON – 3800 SERIES

<b>H 6.1 – REPAIR COUPLING/ NON-RESTRAINED/ TRANSITION (2” THRU 12”):</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b>SPECIFICATION:</b> Non-restraining transmission repair sleeves or couplings shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall connect two plain end pipes of dissimilar or similar diameters.</li> <li>• Shall join pipes with diameter differences as listed in “Minimum Required Coupling Size Range” in a single coupling kit.</li> <li>• Shall have a two layer gasket, with a removable layer to allow for pipe diameter range expansion OR have separate gaskets included in a boxed kit to cover the required size range.</li> <li>• NSF-61 for gaskets and coatings.</li> <li>• Shall be pressure rated for a minimum working pressure of 150psi.</li> <li>• Material supplied must have ISO 9001 or later certification, or poured in a foundry located in the U.S.A.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b>MATERIAL:</b> <b>End Ring &amp; Sleeve Body:</b></p> <ul style="list-style-type: none"> <li>• Carbon Steel.</li> <li>• Ductile Iron.</li> </ul> <p><b>Bolts, Nuts:</b></p> <ul style="list-style-type: none"> <li>• 304 stainless steel with no-gall coating.</li> </ul> <p><b>Gasket:</b></p> <ul style="list-style-type: none"> <li>• EPDM (ethylene propylene).</li> <li>• SBR (styrene butadiene).</li> <li>• Nitrile Buna-N (Acrylonitrile butadiene (NBR)).</li> <li>• Viton; Fluorel (FKM).</li> </ul> <p><b>Coating:</b></p> <ul style="list-style-type: none"> <li>• Coupling Body &amp; end rings: NSF-61 fusion bonded epoxy.</li> </ul>	<p><b>APPLICATION:</b></p> <ul style="list-style-type: none"> <li>• For leak repairs to join two plain end pipes of dissimilar or similar diameters.</li> <li>• For use on cast iron, ductile iron, AC, and PVC pipe.</li> </ul> <p><b>MINIMUM REQUIRED COUPLING SIZE RANGE:</b></p> <ul style="list-style-type: none"> <li>• 2”- (2.375” to 2.50”)-(IPS thru CIP)</li> <li>• 3”- (3.50” to 4.13”)-(IPS thru AC 200)</li> <li>• 4”- (4.50” to 5.35”)-(IPS thru AC 200)</li> <li>• 6”- (6.625” to 7.56”)-(IPS thru AC 200)</li> <li>• 8”- (8.625” to 9.74”)- (IPS thru AC 200)</li> <li>• 10”- (10.75” to 11.95”)-(IPS thru AC 150)</li> <li>• 12”- (12.75” to 13.20”)-(IPS thru DIP)</li> <li>• 12”- (13.20” to 14.38”)-(DIP thru AC 350)</li> </ul> <div style="text-align: center;">  </div>	
<p><b>RESTRICTIONS:</b></p> <ul style="list-style-type: none"> <li>• For repairs to existing, in-service pipelines only.</li> <li>• Shall not be used where joint restraint is required.</li> </ul>	<p><b>MANUFACTURER:</b></p> <ul style="list-style-type: none"> <li>• CASCADE WATERWORK MFG.- OMEGA</li> <li>• CRCER</li> <li>• FORD FC2W</li> <li>• HYMAX</li> <li>• ROMAC MACRO</li> </ul>	



<b>Section I: Castings and Aluminum Covers</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><a href="#">I 1    Valve Boxes</a></p> <p><a href="#">I 2    Service Clean-out Box and Lid</a></p> <p><a href="#">I 3    Manhole Casting/ Standard Ring and Cover</a></p> <p><a href="#">I 4    Access Covers/ Aluminum</a></p>	

<b>I 1 – VALVE BOXES:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION/ MATERIAL:**

Valve boxes shall meet or exceed the performance specifications of:

- Valve boxes shall be screw type.
- Lid shall be marked “WATER” or “SANITARY SEWER” (to match service type application).
- Produced for gray cast iron.
- ASTM Standards A48, Class 30– 35.
- Shall be designed, constructed and capable of withstanding a minimum H-20 type loading.
- Shall be cleaned according to good foundry practice, chipped and ground as needed to remove fins and rough places on castings.
- Shall have a paint or seal-coated finish.
- The lid shall fit flush in the top of the box without forcing and shall not rock.
- Shall have a non-tip lid with a minimum skirt of one and one-half (1-1/2”), for a total lid height of three and one-half (3-1/2”) inches.
- Shall have a five and one quarter (5 1/4”) inch shaft.

**REQUIREMENTS:**

- For federally funded or DOT projects all castings shall be poured at a foundry located in the U.S.A. or have ISO 9001 or later certification.
- Affidavit of compliance.
- All castings shall be true and free of holes.
- All castings shall have manufacturers cast mark and part number clearly visible on each component.
- Fixed riser extensions shall be available for the box top section to be considered for approval.
- Riser sections shall be continuously compatible to achieve any desired height in one (1”) and two (2”) inch increments plus or minus a half (1/2”) inch.
- Locking covers shall be available.



**MANUFACTURER:**

- STAR PIPE PRODUCTS
- TYLER PIPE/ UNION FOUNDRY CO

**RESTRICTIONS:**

**I 2 – SERVICE CLEAN-OUT BOX & LID:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

Service clean-out box and lid shall meet or exceed the performance specifications of:

- Box and lid shall be gray cast iron or ductile iron.
- ASTM Standards A48 Class 30B (gray cast iron).
- ASTM Standards A536 Grade 65-45-12 (ductile).
- Shall be designed, constructed and capable of withstanding a minimum H-20 type loading.
- Shall be cleaned according to good foundry practice chipped and ground as needed to remove fins and rough places on castings.
- Bearing surfaces shall be machined to ensure a proper fit and prevent rattling and fit flush without forcing.
- Lid shall be labeled with "CO" for clean-out.
- A nominal 6" diameter by 12" minimum cast iron box and cover.

**REQUIREMENTS:**

- For federally funded or DOT projects, all castings shall be poured at a foundry located in the U.S.A. or have ISO 9001 or later certification.
- Affidavit of compliance.
- All castings shall be true and free of holes.
- All castings shall have manufacturers cast mark and part number clearly visible on each component.



**MANUFACTURER:**

- U.S. FOUNDRY & MFG. CORP.
- STAR PIPE PRODUCTS
- CAPITOL FOUNDRY OF VIRGINIA
- GENERAL FOUNDRIES, INC.

**RESTRICTIONS:**



**I 3 – MANHOLE CASTINGS/ STANDARD RING & COVER:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

Manhole castings, standard ring and cover, shall meet or exceed the performance specifications of:

- Ring and covers shall be gray cast iron or ductile iron.
- ASTM Standards A48 Class 35B (gray cast iron).
- ASTM Standards A536 Grade 65-45-12 (ductile).
- Shall be designed, constructed and capable of withstanding a minimum H-20 type loading.
- Shall be cleaned according to good foundry practice, chipped and ground as needed to remove fins and rough places on castings.
- Bearing surfaces shall be machined to ensure a proper fit and prevent rattling and fit flush without forcing.
- Cover shall be labeled with "SANITARY SEWER".

**DIMENSIONS:**

- Clear opening – 24" for standard & water tight covers
- Frame height – 7-1/2" located in pavement

**INCLUDE:**

- Ring and covers shall be palletized and banded.
- All covers shall have lifting bars in lieu of pick holes.
- Side sealing gaskets for watertight frame & cover locations.

**REQUIREMENTS:**

- For federally funded or DOT projects all castings shall be poured at a foundry located in the U.S.A. or have ISO 9001 or later certification.
- Affidavit of compliance.
- All castings shall be true and free of holes.
- All castings shall have manufacturers cast mark and part number clearly visible on each component.
- Watertight and bolted covers shall be available.



**MANUFACTURER:**

- CAPITOL FOUNDRY OF VIRGINIA
- GENERAL FOUNDRIES, INC.
- U.S. FOUNDRY & MFG. CORP.
- STAR PIPE PRODUCTS

**RESTRICTIONS:**

- Frame and covers on manholes permanently located in non-traffic areas and elevated 2' or more above finished grade may be considered for non-H20 type loading requirements.



**I 4 – ACCESS COVERS (ALUMINUM):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/ MATERIAL:**

Aluminum access covers shall meet or exceed the performance specifications of:

- Shall be designed, constructed and capable of withstanding a minimum 300-pound per square foot live load.
- If subject to traffic, shall be designed and capable of withstanding a minimum AASHTO HS-20 load.
- Shall have checkered or diamond pattern finish on cover surface.
- Shall have vandal-proof recessed stainless steel hinges.
- Hasp will be fabricated round bar stock mounted vertically and drilled to accept a padlock.
- A fall prevention system shall be incorporated into the access frame.
- Doors over 50 lbs. in pull-weight shall be torsion bar loaded.
- All covers shall have a locking safety handle to hold them in the open position.
- Shall be cast into top slab of wet well or valve vault.
- Shall be sized to provide a clear opening to allow for service and removal of equipment (including pumps).
- For federally funded or DOT projects, access covers must have ISO 9001 or later certification, or manufactured in a factory located in the U.S.A.
- Affidavit of compliance to this specification shall be available upon request.



**FALL PREVENTION SYSTEM:**

**Grate:**

- Shall be FRP or aluminum with 316 stainless steel components.
- Shall withstand a 300 pound per square foot load.
- Shall lock in place and rotate open 90 degrees.
- Shall be removable.

**MANUFACTURER:**

- THE BILCO COMPANY
- HALLIDAY PRODUCTS
- U.S.F. FABRICATION INC.
- OPEN

**RESTRICTIONS:**



**Section J: Service Boxes**Effective Date: 01-01-20  
Revision #: 2

[J 1 Meter Box \(5/8" & 1"\) Single Service Non-Traffic Areas](#)

[J 2 Meter Box \(5/8"\) Dual Service Non-Traffic Areas](#)

[J 3 Meter Box \(5/8" & 1"\) Single Service Traffic Rated](#)

[J 4 Meter Box \(5/8"\) Dual Service Traffic Rated](#)

[J 5 Meter Box \(1 1/2", & 2"\) Single Service Traffic and Non-Traffic Rated](#)

[J 6 Lid Details \(5/8" & 1"\) Single Service Non-Traffic Areas](#)

[J 7 Lid Details \(5/8"\) Dual Service Non-Traffic Areas](#)

[J 8 Lid Details \(5/8" & 1"\) Single Service Traffic Rated](#)

[J 9 Lid Details \(5/8"\) Dual Service Traffic Rated](#)

[J 10 Lid Details \(1-1/2" & 2"\) Single Service Traffic and Non-Traffic Rated](#)

<b>J 1 – METER BOX (5/8" &amp; 1") SINGLE SERVICE NON-TRAFFIC AREAS:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION/MATERIAL:</u></b>                      5/8" &amp; 1" water meter box 1015-12, shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Boxes and Lids shall be designed and tested to meet ASTM C857 load rating standards and have labeling to indicate this loading.</li> <li>• Box and Lid shall be made of a High-Density Polyethylene material.</li> <li>• Box shall be compatible with Lid from Material Specification J 6.</li> </ul> <p><b><u>DIMENSIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Box shall have minimum outside dimensions as follows: 11" wide X 16" long measured at top collar &amp; 16" wide X 20" long measured at box bottom.</li> <li>• Overall height of box shall be 12".</li> </ul> <p><b><u>APPLICATIONS &amp; APPLICATION REQUIREMENTS:</u></b></p> <ul style="list-style-type: none"> <li>• Acceptable in non-traffic applications only.</li> <li>• 5/8" &amp; 1" Single Service metered services.</li> <li>• Box shall be black in color.</li> <li>• See Material Specification J 6 for lid details.</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b>                      Use of this product is limited to:</p> <ul style="list-style-type: none"> <li>• 5/8" &amp; 1" single Service</li> <li>• Acceptable in non-traffic applications only</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• Carson 1015-12 (Part No. 1015-2026)</li> <li>• Or Equal</li> </ul>	

<p><b>J 2 – METER BOX (5/8”) DUAL SERVICE NON-TRAFFIC AREAS:</b></p>	<p>Effective Date: <u>01-01-20</u> Revision #: <u>2</u></p>
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**SPECIFICATION/MATERIAL:**

- 5/8” water meter box 1220-12, shall meet or exceed the performance specifications of:
- Boxes and Lids shall be designed and tested to meet ASTM C857 load rating standards and have labeling to indicate this loading.
- Box and Lid shall be made of a High-Density Polyethylene material.
- Box shall be compatible with Lid from Material Specification J 7.
- Box must have two "mouse holes".

**DIMENSIONS:**

- Box shall have minimum outside dimensions as follows: 14” wide X 21” long measured at top collar & 19” wide X 25” long measured at box bottom.
- Overall height of box shall be 12”.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- Acceptable in non-traffic applications only.
- 5/8” Dual Service metered services.
- Box shall be black in color.
- See Material Specification J 7 for lid details.



**MANUFACTURER:**

- Carson 1220-12 (Part No. 1220-2005)
- Or Equal

**RESTRICTIONS:**  
Use of this product is limited to:

- 5/8” Dual Service
- Acceptable in non-traffic applications only

<b>J 3 – METER BOX (5/8" &amp; 1") SINGLE SERVICE TRAFFIC RATED:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION/MATERIAL:**

5/8" & 1" water meter box 1015-12 BCF-XL, shall meet or exceed the performance specifications of:

- Boxes and Lids shall be designed and tested to meet ASTM A48, Class 30B and ANSI/SCTE 77 Tier 15 load rating standards and have labeling to indicate this loading.
- Box and Lid shall be made of a Polyolefin material.
- Box shall be compatible with Lid from Material Specification J 8.

**DIMENSIONS:**

- Box shall have minimum outside dimensions as follows: 13" wide X 18" long measured at top collar & 9" wide X 14" long measured at box bottom.
- Overall height of box shall be 12".

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- Acceptable in traffic applications only.
- 5/8" & 1" Single Service metered services.
- Box shall be black in color.
- See Material Specification J 8 for lid details.



**MANUFACTURER:**

- Carson 1015-12 BCF-XL (Part No. 1015-2022)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- 5/8" & 1" Single Service
- Acceptable only in occasional, non-deliberate traffic applications.
- Not acceptable in deliberate heavy vehicular traffic applications when AASHTO H-20 load rating is required.

<b>J 4 – Meter Box (5/8”) Dual Service Traffic Rated:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION/MATERIAL:**  
 5/8” Dual traffic rated water meter box 1416-12 BCF-XL, shall meet or exceed the performance specifications of:

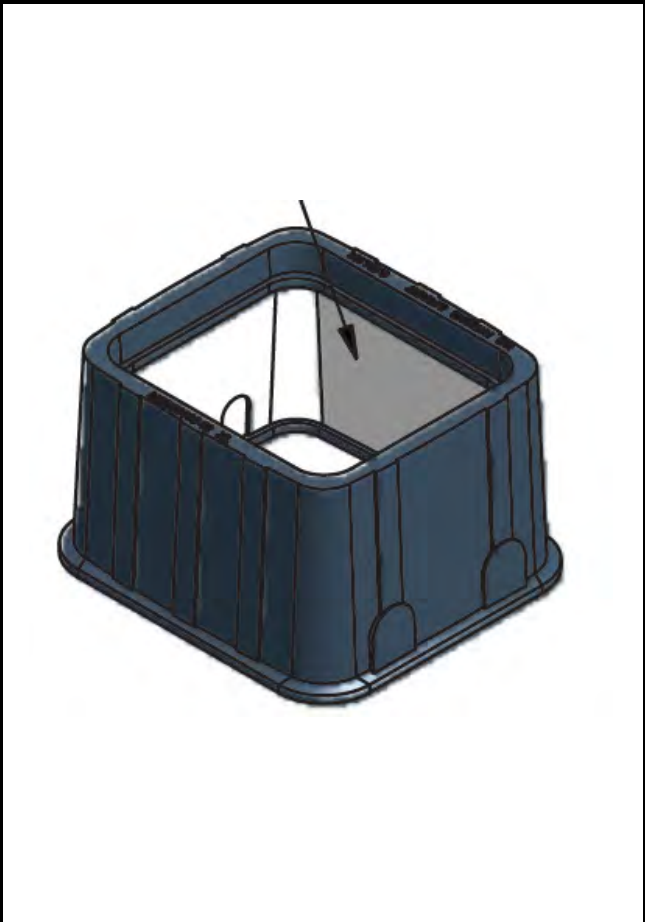
- Boxes and Lids shall be designed and tested to meet ASTM A48, Class 30B and ANSI/SCTE 77 Tier 15 load rating standards and have labeling to indicate this loading.
- Box and Lid shall be made of a Polyolefin material.
- Box shall be compatible with Lid from Material Specification J 9.

**DIMENSIONS:**

- Box shall have minimum outside dimensions as follows: 17” wide X 19” long measured at top collar & 13” wide X 15” long measured at box bottom.
- Overall height of box shall be 12”.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- Acceptable in traffic applications only.
- 5/8” Dual Service metered services.
- Box shall be black in color.
- See Material Specification J 9 for lid details.



**MANUFACTURER:**

- Carson 1416MSBC-XL (Part No. 1416-2006)
- Or Equal

**RESTRICTIONS:**  
 Use of this product is limited to:

- 5/8” Dual Service
- Acceptable only in occasional non-deliberate traffic applications.
- Not acceptable in deliberate heavy traffic applications when ASHTO H-20 is required.

**J 5 – METER BOX (1-1/2" & 2") SINGLE SERVICE TRAFFIC AND NON-TRAFFIC RATED:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION/MATERIAL:**

1-1/2" & 2" water meter box 1730-18 BCF-XL, shall meet or exceed the performance specifications of:

- Boxes and Lids shall be designed and tested to meet ASTM A48, Class 30B and ANSI/SCTE 77 Tier 15 load rating standards and have labeling to indicate this loading.
- Box and Lid shall be made of a Polyolefin material.
- Box shall be compatible with Lid from Material Specification J 10.

**DIMENSIONS:**

- Box shall have minimum outside dimensions as follows: 21" wide X 34" long measured at top collar & 20" wide X 32" long measured at box bottom.
- Overall height of box shall be 18".

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- 1-1/2" & 2" Single Service metered services.
- Box shall be black in color.
- See Material Specification J 10 for lid details.



**MANUFACTURER:**

- Carson 1730-18 BCF-XL (Part No. 1730-1202)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- 1-1/2" & 2" Single Service
- Acceptable in non-traffic and occasional traffic applications
- Not acceptable in deliberate heavy vehicular traffic applications when ASHTO H-20 is required.



<b>J 6 – LID DETAILS (5/8" &amp; 1") SINGLE SERVICE NON-TRAFFIC AREAS:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION/MATERIAL:**

5/8" & 1" water meter Lid 1419 Flush Cover, shall meet or exceed the performance specifications of:

- Lid shall be designed and tested to meet ASTM C857 load rating standards and have labeling to indicate this loading.
- Lid shall be made of a High-Density Polyethylene material.
- Lid shall be compatible with Box from Material Specification J 1.

**DIMENSIONS:**

- Lid shall have minimum outside dimensions as follows: 10" wide X 15" long.
- Lid shall have a 3-3/8" recessed portion for flush mount and a 2" thru hole for the transmitter.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- Acceptable in non-traffic applications only.
- 5/8" & 1" Single Service metered services.
- Lid shall be black in color.
- See Material Specification J 1 for box details.
- The lid shall have a lifting slot with locking pin.
- All lids shall be embossed "Water Meter" and patterned with a non-skid surface.



**MANUFACTURER:**

- Carson 1419 Flush Cover (Part No. 1419-4212)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- 5/8" & 1" Single Service
- Acceptable in non-traffic applications only

**J 7 – LID DETAILS (5/8”) DUAL SERVICE NON-TRAFFIC AREAS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

5/8” water meter TriCast 1220 Dual Pedestrian Cape Fear lid shall meet or exceed the performance specifications of:

- Lid shall be designed and tested to meet ASTM C857 load rating standards and have labeling to indicate this loading.
- Lid shall be made of a High-Density Polyethylene material.
- Lid shall be compatible with Box from Material Specification J 2.

**DIMENSIONS:**

- Lid shall have minimum outside dimensions as follows: 13” wide X 19” long.
- Lid shall have two 3 3/8” recessed portion for flush mount and a 2” thru hole for the transmitters.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- Acceptable in non-traffic applications only.
- 5/8” Dual Service metered services.
- Lid shall be black in color.
- See Material Specification J 2 for box details.
- The lid shall have a lifting slot with locking pin.
- All lids shall be embossed “Water Meter” and patterned with a non-skid surface.



**MANUFACTURER:**

- TriCast - 1220 Dual Pedestrian Cape Fear (Part No. T-CP1220DBR)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- 5/8” Dual Service
- Acceptable in non-traffic applications only

<b>J 8 – LID DETAILS (5/8” &amp; 1”) SINGLE SERVICE TRAFFIC RATED:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION/MATERIAL:**

5/8” & 1” water meter FLX09P Flush Cover, shall meet or exceed the performance specifications of:

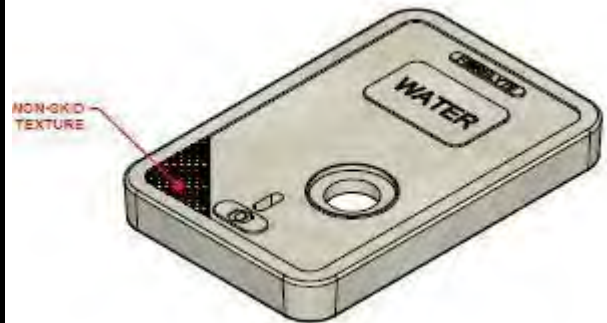
- Lid shall be designed and tested to meet ASTM A48, Class 30B and ANSI Tier 15 load rating standards and have labeling to indicate this loading
- Lid shall be made of a Polyolefin material.
- Lid shall be compatible with Box from Material Specification J 3.

**DIMENSIONS:**

- Lid shall have minimum outside dimensions as follows: 10” wide X 15” long.
- Lid shall have a 3 1/4” recessed portion for flush mount and a 2” thru hole for the transmitter.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- 5/8” & 1” Single Service metered services.
- Lid shall be black in color.
- See Material Specification J 3 for box details.
- The lid shall have a lifting slot with locking pin.
- All lids shall be embossed “Water Meter” and patterned with a non-skid surface.



**MANUFACTURER:**

- Badger Orion FLX09P Flush Cover (Part No. 02001350)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- 5/8” & 1” Single Service
- Acceptable only in occasional non-deliberate traffic applications.
- Not acceptable in deliberate heavy vehicular traffic applications when ASHTO H-20 is required.

**J 9 – LID DETAILS (5/8”) DUAL SERVICE TRAFFIC RATED:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION/MATERIAL:**

5/8” water meter FL1416P Dual Recess Flush Cover, shall meet or exceed the performance specifications of:

- Lid shall be designed and tested to meet ASTM A48, Class 30B and ANSI Tier 15 load rating standards and have labeling to indicate this loading
- Lid shall be made of a Polyolefin material.
- Lid shall be compatible with Box from Material Specification J 4.

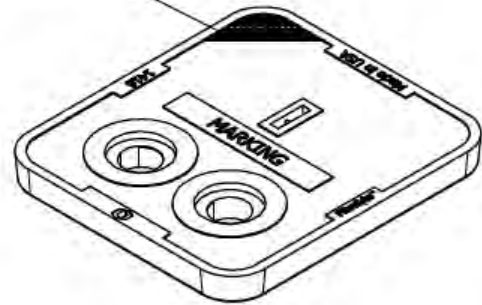
**DIMENSIONS:**

- Lid shall have minimum outside dimensions as follows: 12” wide X 20” long.
- Lid shall have two 3 1/4” recessed portion for flush mount and a 2” thru hole for the transmitters.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- 5/8” Dual Service metered services.
- See Material Specification J 4 for box details.
- The lid shall have a lifting slot with locking pin.
- All lids shall be embossed “Water Meter” and patterned with a non-skid surface.

NON-SKID TEXTURE OMITTED FOR CLARITY



**MANUFACTURER:**

- Badger Orion FL1416P Dual Recess (Part No. 02001399)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- (5/8”) Dual Service
- Acceptable only in occasional non-deliberate traffic applications.
- Not acceptable in deliberate heavy vehicular traffic applications when ASHTO H-20 is required.

<b>J 10 – LID DETAILS (1-1/2" &amp; 2") SINGLE SERVICE TRAFFIC AND NON-TRAFFIC RATED:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION/MATERIAL:**

1-1/2" & 2" water meter FL369P Flush Cover, shall meet or exceed the performance specifications of:

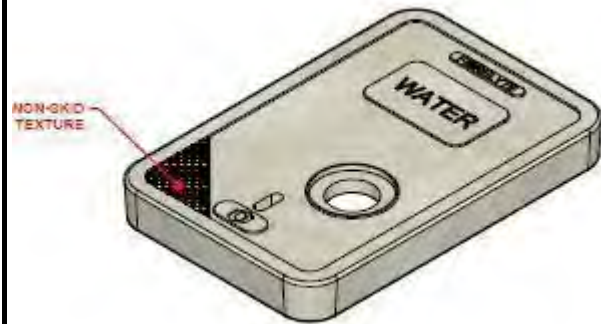
- Lid shall be designed and tested to meet ASTM A48, Class 30B and ANSI Tier 15 load rating standards and have labeling to indicate this loading
- Lid shall be made of a Polyolefin material.
- Lid shall be compatible with Box from Material Specification J 5.

**DIMENSIONS:**

- Lid shall have minimum outside dimensions as follows: 17" wide X 30" long.
- Lid shall have a 3-1/4" recessed portion for flush mount and a 2" thru hole for the transmitter.

**APPLICATIONS & APPLICATION REQUIREMENTS:**

- 1-1/2" & 2" Single Service metered services.
- See Material Specification J 5 for box details.
- The lid shall have a lifting slot with locking pin.
- All lids shall be embossed "Water Meter" and patterned with a non-skid surface



**Manufacturer:**

- Badger Orion FL36P Flush Cover (Part No. 02001576)
- Or Equal

**RESTRICTIONS:**

Use of this product is limited to:

- (1-1/2" & 2") Single Service
- Acceptable in non-traffic and occasional non-deliberate traffic applications.
- Not acceptable in deliberate heavy vehicular traffic applications when ASHTO H-20 is required.



**Section K: Miscellaneous**Effective Date: 01-01-20  
Revision #: 2

- [K 1 Casing Insulators/ Stainless Steel](#)
- [K 2 Polyethylene Encasement](#)
- [K 3 Manhole Inserts](#)
- [K 4 Pipe Saddle Support/ Valve Vaults/ Adjustable](#)
- [K 5 Cylindrical Wall Seals & Line Sleeves](#)
- [K 6 Metal Detectable Underground Warning Tape](#)
- [K 7 Sanitary Sewer/ Inside Drop Bowls](#)
- [K 8 Flange Insulating Gasket Kits](#)
- [K 9 Sampling Station](#)

**K 1 – CASING INSULATORS/ STAINLESS STEEL:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Casing Insulators shall meet or exceed the Performance specifications of:

- Must ensure electrical insulation between the two pipes.
- Shall permanently prevent bells from resting on casing pipe.
- Shall be resistant to corrosion.
- Band widths of 8” or 12”.

**MATERIAL:**

**Panel & Riser:**

- Type 304 stainless steel per ASTM Standards A240.

**Liner:**

- Elastomeric PVC per ASTM Standards D149 or extruded EPDM rubber.

**Skids:**

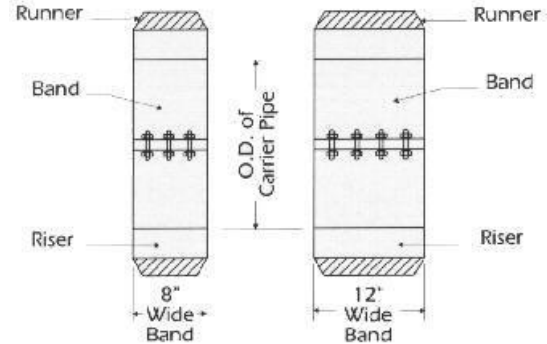
- Glass reinforced nylon or Ultra High Molecular Weight (UHMW) polyethylene per ASTM Standards D638.

**Fasteners:**

- Type 316 stainless steel per ASTM Standards A193.

**REQUIREMENTS:**

- Band width requirement determined by weight, pipe and fluid, and spacing.



**MANUFACTURER:**

- BWM COMPANY- MODEL BWM-SS
- CASCADE WATERWORKS- MODEL CCS
- CCI PIPELINE SYSTEMS- MODEL CSS
- PIPELINE SEAL AND INSULATOR- MODEL S8G-2 & S12G-2
- POWER SEAL- MODEL 4810
- SPIDER MFG. INC.

**RESTRICTIONS:**



**K 2 – POLYETHYLENE ENCASEMENT:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Polyethylene film shall meet or exceed the performance specifications of:

- ANSI/ AWWA C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
- Shall have minimum thickness of 0.008” or 8-mil.
- Shall be linear low-density polyethylene film.
- Shall be supplied in rolled tube form, suitable for installation method “A” as outlined in reference standard.
- The tube shall be sized according to the pipe being protected.
- Film shall be color coded.

**COLOR-CODED:**

- Blue– potable water
- Green– sanitary sewer/ force main

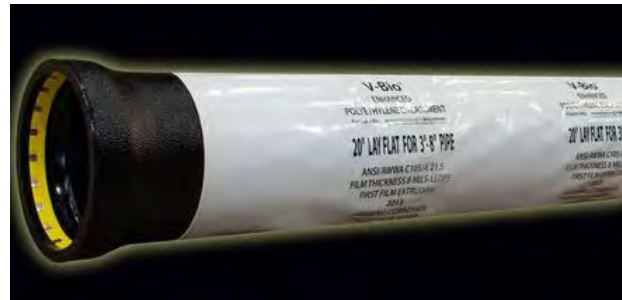
**TUBE SIZE:**

Nominal pipe diameter Minimum flat tube width

4”	14”
6”	16”
8”	20”
10”	24”
12”	27”
14”	30”
16”	34”
18”	37”
20”	41”
24”	54”
30”	67”
36”-42”	81”
48”	95”

**MARKING REQUIREMENTS:**


- Manufactures name or trademark
- Year of manufacture
- ANSI/ AWWA C105/ A21.5
- Thickness/ type (LLDPE)
- Size
- Warning- Corrosion Protection- Repair Any Damage



**MANUFACTURER:**

- OPEN

**RESTRICTIONS:**

<b>K 3 – MANHOLE INSERT:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Manhole inserts shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall reduce or eliminate inflow thru manhole cover.</li> <li>• Shall have a deep-dish design to allow for easy removal and replacement of the manhole cover (i.e., cover rotation).</li> <li>• Body shall be manufactured of high density copolymer (HDPE) for non-traffic area.</li> <li>• Body shall be manufactured of 304 stainless steel with a thickness of not less than 18-gauge for traffic areas.</li> <li>• Shall have a sealing gasket made of Nitrile Buna-N (Acrylonitrile butadiene (NBR)), EPDM (Ethylene Propylene Diene Monomer) or closed cell neoprene.</li> <li>• Shall have a handle made of 1/8" minimum, 304 stainless steel cable. Plastic coating of handle is optional or 1" heavy weight polypropylene.</li> <li>• The handle shall be attached using two 304 stainless steel round head bolts with flat washers and self locking bolts or stainless steel pop rivets.</li> </ul> <p><b><u>ADDITIONAL REQUIREMENTS:</u></b> When hydrogen sulfide (H2S) gas levels warrant relief; a relief valve shall be provided and meet the following:</p> <ul style="list-style-type: none"> <li>• The gas relief valve shall be designed to release at a pressure of 0.5 to 1.5 psi and have a water leak down rate no greater than 5 gallons per 24 hours.</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• ROWLAND INC. - INFLOW SHIELD</li> <li>• SEALING SYSTEMS INC.</li> <li>• SOUTHWESTERN PACKING &amp; SEALS - RAINSTOPPER</li> <li>• OPEN</li> </ul>	

<b>K 4 – PIPE SADDLE SUPPORT/VALVE VAULTS/ADJUSTABLE:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Adjustable pipe saddle supports shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall be a stanchion type support for vertical adjustment of stationary pipe.</li> <li>• Shall comply with Federal Specification A-A-1192A (type 38) and the Manufactures Standardization Society (MMS), MSS-SP-69 (type 38).</li> <li>• Material shall be an assembled cast iron saddle, locknut nipple and special cast iron reducer.</li> <li>• Shall have a Galvanized finish.</li> <li>• Shall be capable of vertical adjustments of 4-1/2”.</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• For supporting pipe in pump station valve vaults only.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• ANVIL INTERNATIONAL, INC.- MODEL 264</li> <li>• EMPIRE</li> <li>• OPEN</li> </ul>	

**K 5 – CYLINDRICAL WALL SEALS & LINE SLEEVES:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Cylindrical wall seals & line sleeves shall meet or exceed the performance specifications of:

- Rubber links shall meet ASTM D2000 M3 BA510.
- Stainless steel shall meet ASTM F593, with a 85,000 psi average tensile strength.
- Hydrostatic seal shall be capable of holding 20 psig (40 feet of head) between the pipe and barrier through which it passes.
- Wall sleeves shall be high impact resistant HDPE or PVC.
- Wall sleeves shall have a integral water stop collar.
- Hole forming disks can be used for holes above 29” in diameter.
- Pressure plates shall be a composite material.
- Components and system shall be manufactured at a plant with a current ISO-9001:2000 registration.

**MATERIAL:**

**Bolts and nuts:**

- ANSI type 316 Stainless Steel.

**Pressure plates:**

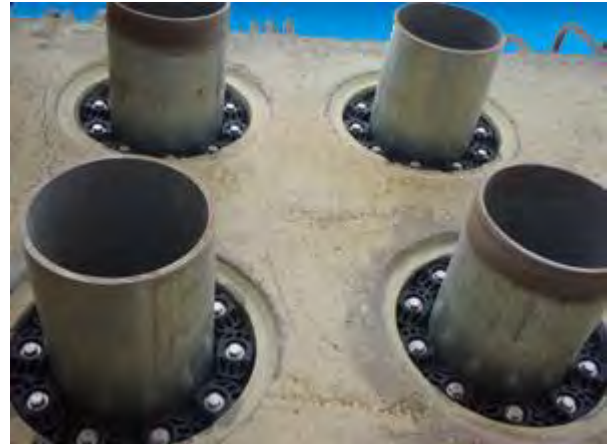
- Reinforced nylon polymer.

**Gasket:**

- Nitrile Buna-N.
- EPDM (Ethylene Propylene Diene Monomer).
- Viton; Fluorel (FKM) (Fluorocarbon).

**ADDITIONAL INFORMATION:**

- For pipe penetrations through concrete vaults.
- Holes can be cored into concrete barriers.



**MANUFACTURER:**

- ADVANCE PRODUCTS & SYSTEMS, INC. MODELS “ S-304”, “S-316”, “OS-304”, “OS-316”
- PIPELINE SEAL AND INSULATOR, INC.-
- LINK-SEAL- MODELS “S-316” & “OS-316”
- OPEN

**RESTRICTIONS:**

<b>K 6 – METAL DETECTABLE UNDERGROUND WARNING TAPE:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Metal detectable underground tape shall meet or exceed the performance specifications of:

- Shall have a solid aluminum foil core with permanent printing under a protective layer to maintain the integrity and legibility of the warning sign.
- The aluminum core shall be laminated with a polyethylene layer.
- The inert polyethylene plastic shall be impervious to all known alkalis, acids, chemical reagents, and solvents likely to be encountered in the soil.
- Tape shall have a minimum thickness of 5 mils.
- The warning label shall be in black ink.
- The warning label shall be printed over a background color matching the type service.
- Affidavit of compliance to this specification shall be available upon request.

**REQUIREMENTS:**

**Color code:**

- Blue: Potable Water
- Green: Sanitary Sewer

**Width:**

- Minimum of 2-inches.



**MANUFACTURER:**

- EMPIRE LEVEL MFG. CORP.
- MERCO TAPE COMPANY- M225
- PRESCO
- TRUMBULL- 364-49XX
- OPEN

**RESTRICTIONS:**

- Required for all force mains
- Required for all portable water mains

**K 7 – SANITARY SEWER INSIDE DROP BOWL:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Sanitary sewer inside drop bowls shall meet or exceed the performance specifications of:

- Shall be a plastic composite collection device designed to facilitate a controlled drop of effluent into the main stream flow of a sanitary sewer manhole.
- Shall be fabricated from marine grade fiberglass.
- Shall have an optional hood for use in force main applications.
- Clamping pipe supports brackets shall be manufactured from totally non-magnetic 11-gauge type 316 stainless steel.
- Bolts, washers and nuts shall be manufactured from totally non-magnetic 18-8 316 stainless steel.
- Secure bowl and pipe support brackets to wall with lead tamp-in expansion anchors.
- Seal bowl to wall with an approved marine grade high-performance polyurethane adhesive sealant.
- Connection from drop bowl to drop pipe shall be by approved external flexible pipe adapter.
- The bowl size shall be determined by incoming pipe size and flow rate.
- The bowl assembly shall be installed as per manufacturer’s instructions.
- Affidavit of compliance to this specification shall be available upon request.



**MANUFACTURER:**

- DURAN INC.- RELINER INSIDE DROP SYSTEM
- OPEN

**RESTRICTIONS:**

- Must be approved by CFPUA.
- For manhole rehabilitation only.



**K 8 – FLANGE INSULATING GASKET KITS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Flange insulating gasket kits shall meet or exceed the performance specifications of:

- Designed and manufactured to work with flange pipe and fittings per ANSI B16.1 125 pound class specifications.
- Shall create an insulated joint to separate a branch connection from a cathodically protected pipeline.
- Nuts, bolts and gasket shall be designed to withstand the design and test pressures of the pipe.
- Each kit shall be individually packaged in a reinforced cardboard box, which is clearly labeled as to its contents.

**MUST INCLUDE:**

**Gasket:**

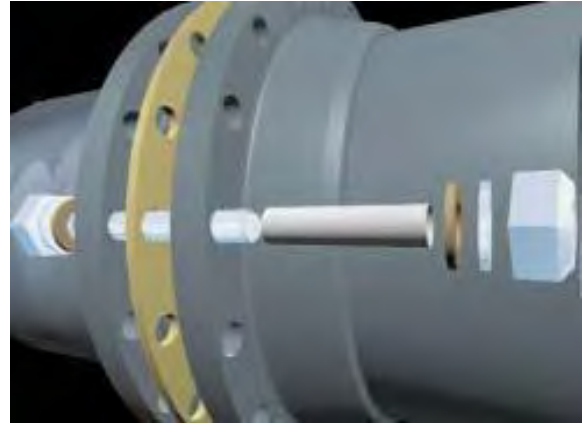
- Gasket shall be full-faced isolating and sealing – Type “E”, 1/8 inch thick, manufactured from Nema grade G-10 glass reinforced epoxy retainer with a Nitrile, Viton or EPDM seal. The G-10 retainer shall have a 550 volt/mil dielectric strength and a minimum 50,000 psi compressive strength.

**Sleeve:**

- Shall have one full length Nema grade G-10 sleeve for every flange bolt. The G-10 shall be a 1/32 inch thick tube with a 400 volt/mil dielectric strength.

**Washer:**

- Shall have two insulating washers manufactured from Nema grade G-10 glass reinforced epoxy for each bolt hole. Their compressive strength shall be 50,000 psi, dielectric strength 550 volts/mil. Two, 1/8 inch thick zinc plated, hot rolled steel washers for each bolt. The I.D. of all washers shall fit over the isolating sleeve and both the steel and isolating washers shall have a same I.D. and O.D.
- Products supplied must have ISO 9001 or later certification.
- Affidavit of compliance to this specification shall be available upon request.



**MANUFACTURER:**

- ADVANCE PRODUCTS & SYSTEMS, INC.
- PIPELINE SEAL AND INSULATOR, INC.
- OPEN

**RESTRICTIONS:**

- Must be approved by CFPUA, for insulating cathodically protected aerial pipelines only.

**K 9 – Sampling Station:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Sampling Stations shall meet or exceed the performance specifications of:

- Stainless steel standpipe with 1" fittings and connections and a 3/4" reducer.
- All stations shall be enclosed in a lockable, nonremovable, aluminum-cast housing.



**MANUFACTURER:**

- KUPFERLE FOUNDRY COMPANY
- OPEN

**RESTRICTIONS:**



**Section L: Electrical**

Effective Date: 01-01-20  
Revision #: 2

[L 1 Tracer Wire \(Solid Copper\)](#)

[L 1.1 Tracer Wire \(Copper Clad Steel\)](#)

[L 2 Direct Bury Wire Splice Kit](#)

**L 1 – TRACER WIRE (SOLID COPPER):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Tracer wire shall meet or exceed the performance specifications of:

- Manufactured for the purpose of direct burial power applications in accordance with the National Electric Code.
- Conductor shall be soft drawn bare copper meeting the requirements of ASTM Standard Specification B-3.
- Shall be a minimum gauge size 10.
- Conductor shall be solid strand.
- Insulation shall be polyvinylchloride (PVC) or low density, high molecular weight polyethylene for applications of up to 600 volts.
- Insulation shall be color coded per type service.
- Shall be constructed in accordance with Underwriter Laboratories, Inc.
- Thermoplastic Heat and Water resistant Nylon coated (THWN).

**COLOR-CODED:**

- Blue: Potable water
- Green: Sanitary sewer/ force main



**MANUFACTURER:**

- OPEN

**RESTRICTIONS:**

- For service lines up to 2" in diameter installed by directional drill.

**L 1.1 – TRACER WIRE (COPPER CLAD STEEL):**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Tracer wire (Copper-Clad Steel Wire) shall meet or exceed the performance specifications of:

- Conductor shall be copper-clad steel wire composed of a steel core with a uniform and continuous copper cladding thoroughly bonded to the steel throughout.
- Cladding: The steel and copper Interface must have a metallurgical bond achieved through a high heat and pressure bonding process. Established process for porosity-free material.
- Steel: Extra high strength with 0.54 carbon or greater. Verified to meet required mechanical properties.
- Copper: UNS-C10200; of copper according to ASTM B-170 (latest revision). High conductivity, oxygen free copper to achieve optimal signal performance.
- Shall be a minimum gauge size 12AWG (.0808" diameter).
- Shall have an average tensile break load of 1100 lbs.
- Conductor shall be solid strand.
- Surface Condition; Shall be free of any defects, including flakes, grooves, pits, and voids. Wire shall be smooth, bright and shiny, and free of excessive copper dust and residual drawing lubricants.
- Insulation shall be color coded per type service.

**INSULATION & THICKNESS REQUIREMENTS:**

- Insulation shall be high molecular weight-high density polyethylene (HDPE) jacket complying with ASTM-D1248, 30-volt rating.
- 30 mil insulation for 2" to 8" pipe Installed by directional drill and all sizes installed by open cut.
- 45 mil insulation for 10" and larger pipe and all subaqueous pipe installed by directional drill.

**COLOR-CODED:**

- Blue: Potable water
- Green: Sanitary sewer/ force main

**RESTRICTIONS:**

- Shall not be used in open cut installations.
- Required on pipe installed by horizontal directional drill.



**MANUFACTURER:**

- Copperhead Industries LLC. - 1245X EHS
- OPEN

**L 2 – DIRECT BURY SPLICE KITS:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Direct bury water proof wire connectors shall meet or exceed the performance specifications of:

- UL Standards 486D, direct bury wire splices.
- Shall be compatible with THWN insulation thickness and AWG solid strand copper wiring.
- Shall use a silicone insulating gel sealant.

**DESIGN:**

- Shall splice and effectively moisture seal three to four (minimum) # 10 conductors as part of the installation of tracer wire in pipe line construction.





**MANUFACTURER:**

- 3M- DBR-6 DIRECT BURY SPLICE KIT
- KING INNOVATION– KING 6 BLUE

**RESTRICTIONS:**

<p><b>Section M: Coatings &amp; Sealants</b></p>	<p>Effective Date: <u>01-01-20</u>                  Revision #: <u>2</u></p>
<p><a href="#">M 1 Chemically Activated Acrylic Gel</a></p> <p><a href="#">M 1.1 Chemically Activated Acrylamide Gel</a></p> <p><a href="#">M 1.2 Water Activated Polymer Solution/ Foam</a></p> <p><a href="#">M 2 Pipe Gasket Lubricants</a></p> <p><a href="#">M 3 PTFE “Teflon” Thread Sealant Tape</a></p> <p><a href="#">M 4 Flexible Joint Sealants</a></p> <p><a href="#">M 4.1 Flexible Butyl Joint Sealants</a></p> <p><a href="#">M 5 Polyurethane Adhesive Sealant/ Caulk</a></p> <p><a href="#">M 6 Protecto 401 / Permox CTF / Tnemec Series 431 Permashield PL Touch-up Kit</a></p>	

<b>M 1 – CHEMICALLY ACTIVATED ACRYLIC GEL:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Chemically activated acrylic gel (grout) shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall be a water solution of acrylic resin.</li> <li>• Shall form an elastic and cohesive gel with the addition of a catalyst which stops flowing water.</li> <li>• Gel set time shall be controllable from a few seconds to several hours even in flowing water.</li> <li>• Shall have approximately the same viscosity as water (1 to 2 centipoises) in solution.</li> <li>• When catalyzed, shall produce a gel which is nontoxic.</li> <li>• Shall have a tracer dye added if colorless.</li> <li>• Shall be mixed and applied per manufactures recommendations.</li> </ul> <p><b><u>CATALYST:</u></b></p> <ul style="list-style-type: none"> <li>• AV-101 Catalyst T+ or Chemical grout monomer, Triethanolamine (TEA) catalyst &amp; water.</li> <li>• AV-103 Catalyst SP or Sodium Persulfate (SP) initiator &amp; water.</li> </ul> <p><b><u>POSSIBLE ADDITIVES:</u></b></p> <ul style="list-style-type: none"> <li>• AV-105 Ethylene Glycol: Protects against freezing.</li> <li>• AV-257 Icaset: Increases compressive and tensile strength.</li> <li>• AC 50W: Root Inhibitor.</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b> For sealing existing or rehabilitated, in-service gravity sewers and manholes including:</p> <ul style="list-style-type: none"> <li>• Sewer joint sealing.</li> <li>• Sewer laterals.</li> <li>• Manhole waterproofing.</li> <li>• Lateral connections to cured in-place liners.</li> <li>• Not for potable water applications.</li> <li>• For soil stabilization.</li> <li>• Shall not be used after 6-12 months from manufactures date depending on manufacture.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AVANTI INTERNATIONAL- AV-118 DURIFLEX ACRYLIC GEL</li> <li>• DE NEEF CONSTRUCTION CHEMICALS INC.- AC-400 ACRYLATE GROUT</li> <li>• OPEN</li> </ul>	

<b>M 1.1 – CHEMICALLY ACTIVATED ACRYLAMIDE GEL:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Chemically activated acrylamide gel (grout) shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall be a water solution of three or more chemicals which is a blend of Acrylamide Monomer (AM) and Methylenebisacrylamide (MBA).</li> <li>• Shall form an elastic and cohesive gel with the addition of catalysts which stops flowing water.</li> <li>• Gel set time shall be controllable from a few seconds to several hours even in flowing water.</li> <li>• Shall have approximately the same viscosity as water (1 to 2 centipoises) in solution.</li> <li>• Shall have a tracer dye added.</li> <li>• Shall be mixed and applied per manufactures recommendations.</li> </ul> <p><b><u>CATALYST:</u></b></p> <ul style="list-style-type: none"> <li>• AV-101 Catalyst T+.</li> <li>• AV-102 Catalyst AP.</li> </ul> <p><b><u>POSSIBLE ADDITIVES:</u></b></p> <ul style="list-style-type: none"> <li>• AV-105 Ethylene Glycol: Protects against freezing.</li> <li>• AV-257 Icoset: Increases compressive and tensile strength.</li> <li>• AC 50W: Root Inhibitor.</li> <li>• Dye: Tracer Dyes</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b> For sealing existing or rehabilitated, in-service gravity sewers and manholes including:</p> <ul style="list-style-type: none"> <li>• Sewer joint sealing.</li> <li>• Sewer laterals.</li> <li>• Manhole waterproofing.</li> <li>• Lateral connections to cured in-place liners.</li> <li>• Not for potable water applications.</li> <li>• For soil stabilization.</li> <li>• Shall not be used after 12 months from manufacture date.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• AVANTI INTERNATIONAL- AV-100</li> <li>• OPEN</li> </ul>	

<b>M 1.2 – WATER ACTIVATED POLYMER SOLUTION/ FOAM:</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
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**SPECIFICATION:**

Water activated polymer solution which cures when reacted with water (grout) shall meet or exceed the performance specifications of:

- Shall prevent water infiltration unto sub-grade structures and pipes.
- Shall be either hydrophilic or hydrophobic polyurethane.
- Shall form a strong film, gel, or foam of polyurethane, with the addition of or contact with water, which stops flowing water.
- Shall have an approximate viscosity of 120- 2500 centipoises in solution.
- Shall be mixed and applied per manufactures recommendations.
- Shall be supplied in cartridges for use with or without a caulking gun.



**MANUFACTURER:**


- AVANTI INTERNATIONAL- AV-202 MULTIGROUT
- DE NEEF CONSTRUCTION CHEMICALS, INC.- HYDRO-ACTIVE CUT “HOT SHOT”
- OPEN


**RESTRICTIONS:**


For sealing existing or rehabilitated, in-service gravity sewers and manholes including:

- Large cracks or joints in concrete.
- Precast structures.
- Manhole waterproofing.
- Manhole connections or pipe penetrations.



<b>M 2 – PIPE GASKET LUBRICANTS:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Pipe gasket lubricants shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• AWWA C-111 (ANSI-A21.11), Rubber-gasket joints for ductile-iron pressure pipe and fittings.</li> <li>• Shall be suitable for lubricating the parts of the joint for assembly.</li> <li>• Shall be nontoxic.</li> <li>• Shall not support the growth of bacteria.</li> <li>• Shall have no deteriorating effects on the gasket material.</li> <li>• Shall not impart taste or odor to the water in the pipe.</li> <li>• Containers shall be labeled with the trade name of the lubricant.</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul>		
<p><b><u>RESTRICTIONS</u></b></p>		<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• EASE-ON PIPE JOINT LUBRICANT</li> <li>• J.C. WHITLAM- BLUE LUBE</li> <li>• OPEN</li> </ul>

<b>M 3 – PTFE “TEFLON” THREAD SEALANT TAPE:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>																
<p><b><u>SPECIFICATION:</u></b> PTFE (polytetrafluoroethylene) “Teflon” thread sealant tape shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall meet MIL-T-27730A specifications.</li> <li>• Shall be Underwriters Laboratory Listed as noted (UL).</li> <li>• Shall comply with and be labeled as approved by the National Sanitation Foundation (NSF) for use in potable water lines meeting NSF 61.</li> <li>• Shall be nontoxic.</li> <li>• Shall not support the growth of bacteria.</li> <li>• Shall not impart taste or odor to the water in the pipe.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>ADDITIONAL REQUIREMENTS:</u></b></p> <table border="0"> <tr> <td>• Color</td> <td>White</td> </tr> <tr> <td>• Density</td> <td>Standard .5 - .7</td> </tr> <tr> <td>• Thickness</td> <td>.003" - .0038"</td> </tr> <tr> <td>• Temperature</td> <td>-450°F to +500°F</td> </tr> <tr> <td>• Pressure</td> <td>Hard vacuum to 10,000 PSI.</td> </tr> <tr> <td>• Package</td> <td>Plastic Spool &amp; Shell</td> </tr> <tr> <td>• Width</td> <td>.75" or 1"</td> </tr> <tr> <td>• Length per spool</td> <td>260" or 520"</td> </tr> </table>		• Color	White	• Density	Standard .5 - .7	• Thickness	.003" - .0038"	• Temperature	-450°F to +500°F	• Pressure	Hard vacuum to 10,000 PSI.	• Package	Plastic Spool & Shell	• Width	.75" or 1"	• Length per spool	260" or 520"	
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<p><b><u>RESTRICTIONS:</u></b></p>		<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• MERCO TAPE COMPANY- M55</li> <li>• OPEN</li> </ul>																

<b>M 4 – FLEXIBLE JOINT SEALANTS:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b>                  Preformed flexible plastic joint sealant (gaskets) shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• ASTM C-990 standard specification for joints, concrete pipe, manholes and pre-cast box sections.</li> <li>• Federal Specification SS-S210-A, "Sealing Compound Preformed Plastic for Pipe Joints", Type 1, Rope Form.</li> <li>• AASHTO M-198 75 1.</li> <li>• Shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler.</li> <li>• Shall appear as a semi-solid black strip.</li> <li>• Shall contain no solvents, irritating fumes or obnoxious odors.</li> <li>• The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.</li> <li>• Shall be supplied in extruded rope-form of suitable cross-section and of such size as to fill the joint space when manhole sections are stacked.</li> <li>• Shall be protected by a suitable removable two-piece wrapper.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul>		
<p><b><u>RESTRICTIONS:</u></b></p>		<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• HENRY COMPANY- RAM-NEK/ RN101</li> <li>• OPEN</li> </ul>

**M 4.1 – FLEXIBLE BUTYL JOINT SEALANTS:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Preformed flexible butyl plastic joint sealant (gaskets) shall meet or exceed the performance specifications of:

- ASTM C-990 standard specification for joints, concrete pipe, manholes and pre-cast box sections.
- Federal Specification SS-S210-A, "Sealing Compound Preformed Plastic for Pipe Joints", Type 1, Rope Form.
- AASHTO M-198B.
- Shall be produced from special blend of butyl and asphalt.
- Shall appear as a extruded black fluid coil.
- Shall be protected by a suitable removable two piece wrapper.
- Affidavit of compliance to this specification shall be available upon request.



	TEST	REQUIRED
<b>Chemical Composition</b>		
Hydrocarbon, % by weight	METHOD ASTM D 4-80	50-70
Inert Mineral Filler, % by weight	AASHTO T111	30-50
Volatile Matter, % by weight	ASTM D 6-80	2.0 Max.
<b>Physical Properties*</b>		
Specific gravity, @ 77F.	ASTM D 71-84	1.2-1.35
Ductility at 77F, cm	ASTM D 113-85	5.0 min.
Softening Point, Ring & Ball, @ 77F	ASTM D 36-86	320 min.
Penetration, Cone, @ 77 F, 150 g, 5 sec., in 0.1 mm	ASTM D 217-82	50-120
Flash Point, Cleveland Open Cup, F	ASTM D 92-85	600 min.
Fire Point, Cleveland Open Cup, F	ASTM D 92-85	625 min.
Compression Test @77° F lbf/in <sup>2</sup>	ASTM C 972	100 max.
Compression Test @ 32° F lbf/in <sup>2</sup>	ASTM D 972	200 max.
<b>Sag or Flow Resistance</b>		
Sag or flow resistance, in vertical position for 5 days @ 135 F	FS SS-S-210A sect. 4.5/ASTM C 990	No sagging
<b>Chemical Resistance</b>		
30 days immersion @ room temperature in each of the following:	FS SS-S-2120A sect. 3.6/ASTM C 990	
5% Solution of Caustic Potash		No visible Deterioration
5% Solution of Hydrochloric Acid		No visible Deterioration
5% Solution of Sulfuric Acid		No visible Deterioration
Saturated Hydrogen Sulfide Solution		No visible Deterioration

**MANUFACTURER:**

- HENRY COMPANY- BUTYL-NEK/ BN109
- OPEN

**RESTRICTIONS:**

**M 5 – POLYURETHANE ADHESIVE SEALANT/ CAULK:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

High-performance polyurethane adhesive & sealant shall meet or exceed the performance specifications of:

- Shall be a high-performance marine grade polyurethane adhesive sealant.
- Shall have a minimum tensile strength of 600 psi.
- Shall have a minimum 900% elongation before breaking.
- Shall be suitable for above and below water applications.
- Shall not shrink.
- Shall create a permanent bond with fiberglass and gel coat material.
- Affidavit of compliance to this specification shall be available upon request.

**INTENDED USE:**

- Installation of inside drop bowl.
- Sealing of bowl to manhole wall.



**MANUFACTURER:**

- 3M MARINE ADHESIVE SEALANT 5200
- 3M MARINE ADHESIVE SEALANT FAST CURE 5200

**RESTRICTIONS:**

**M 6 – PROTECTO 401 / PERMOX CTF / TNEMEC SERIES 431  
PERMASHIELD PL TOUCH-UP KIT:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Touch-up kits shall meet or exceed the performance specifications of:

- Shall be applied per manufactures procedure.
- Affidavit of compliance to this specification shall be available upon request.

**SURFACE PREPARATION:**

- The surface preparation shall be equal to the specifications for the project or as outlined in the touch-up procedure.
- Shall not be applied over wet or frozen surfaces.

**APPLICATION DATA:**

- Dry film thickness shall be as outlined in specifications.

**INTENDED USE:**

- Sealing of cut ends of lined pipe.
- Repairing field damaged areas of lined pipe and fittings.




**MANUFACTURER:**

- PROTECTO 401
- PERMOX CTF
- TNEMEC SERIES 431 PERMASHIELD PL

**RESTRICTIONS:**

<b>Section N: Concrete</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><a href="#">N 1 Concrete/ Type S Mortar</a></p> <p><a href="#">N 2 Cement/ Calcium Aluminate</a></p> <p><a href="#">N 3 Cement/ Calcium Aluminate Lining System/ Sanitary Sewer</a></p> <p><a href="#">N 4 Concrete/ High Early Concrete Mix</a></p> <p><a href="#">N 5 Non-Shrink Grout</a></p>	



<b>N 1 – CONCRETE/ TYPE S MORTAR:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Type S Mortar shall meet or exceed the performance specification of:</p> <ul style="list-style-type: none"> <li>• ASTM C1329, ASTM C270</li> <li>• All walls shall be cleaned and free from orange material and harmful amount of dissolved acids, alkalies, and salts.</li> <li>• Resistance to freeze – thaw deterioration.</li> </ul> <p><b><u>TECHNICAL DATA:</u></b></p> <ul style="list-style-type: none"> <li>• Compressive Strengthen</li> <li>• 7 Days – 1300 psi</li> <li>• 28 Days – 2100 psi</li> </ul>		
	<p><b><u>RESTRICTIONS:</u></b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• QUIKRETE</li> <li>• CEMEX</li> <li>• OPEN</li> </ul>



**N 2 – CEMENT/ CALCIUM ALUMINATE:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Calcium aluminate cement shall meet or exceed the performance specifications of:

- Made with 100% fused calcium aluminate aggregate and calcium aluminate cement.

Compressive strength per ASTM C109 shall meet the following minimums:

- 1 hour – 400psi
- 24 hours – 2000psi
- 28 days – 9000 psi
- Shall have a minimum bond of 2000psi per ASTM C882.
- Shall have no shrinkage @ 95% R.H. per ASTM C596.

**APPLICATION:**

- For use where harsh hydrogen sulfide conditions exist in sanitary sewers.
- For construction or reconstruction of the bench and invert in concrete, masonry, or inert (such as fiberglass) lined manholes, wet wells and lift stations.



**MANUFACTURER:**

- STRONG SEAL– BENCH MIX
- OPEN

**RESTRICTIONS:**

- Only permitted for the rehabilitation or reconstruction of manhole benches.

**N 3 – CEMENT/ CALCIUM ALUMINATE LINING SYSTEM/ SANITARY SEWER:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Calcium aluminate cement lining system shall meet or exceed the performance specifications of:

- Lining material shall provide a corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater and to prevent infiltration.
- Shall be 100% calcium aluminate cement with 100% calcium aluminate aggregate.
- Manufacture shall warrant material and workmanship for a minimum period of ten (10) years.
- Shall be designed to withstand long-term exposure to a bacterially corrosive hydrogen sulfide environment that may be expected to produce a pH of 1 on normal Portland Cement concrete or typical brick and mortar surfaces.
- Mortar furnished under this specification shall be a pre-packaged mortar, including all cement, aggregate, and any required admixtures of fibers.
- It is the intent of this specification that the contractor only be required to add the proper amount of potable water so as to produce a mortar suitable for pneumatic application.
- Typical package weights shall not be less than 50 pounds.
- To ensure total unit responsibility, all materials and installation shall be furnished by, and coordinated with, one supplier/ manufacture.
- The chemical composition of the cement portion as well as the aggregates of the mortar mix shall be as follows:

Chemical analysis main constituents			
Al <sub>2</sub> O <sub>3</sub>	CaO	FeO+Fe <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>
39% - 44%	34% - 38%	9% - 15%	6% - 8%

**RESTRICTIONS:**

- Use of this product is restricted to coating rehabilitation of existing manhole structures.

The design properties of the mortar mix shall be as follows:

TYPICAL MATERIAL PROPERTIES* (PERFORMED BY AN INDEPENDENT TESTING LABORATORY @ 14-16% water)				
	SEWPERCOAT® PG	24 HRS	7 DAYS	28 DAYS
ASTM C 109	Compressive Strength, psi	>5,500	>6,000	>7,000
ASTM C 348	Flexural Strength, psi	>900	>1,100	>1,300
ASTM C 157	Shrinkage after 28d immersion, %	< 0.04	< 0.05	< 0.07
ASTM C 496	Splitting Tensile Strength, psi	>550	>600	>700
ASTM C 682	Bond Strength by Slant Shear, psi		>2500	>2500
ASTM C 666	Freeze-Thaw - 300 cyc, Rel. Dyn. Modulus		102	
ASTM C 642	Volume of Permeable Voids (40 days), %		15	
ASTM C 642	Apparent Density (40 days)		2.74	
ASTM C 469	Modulus of Elasticity (28 days), ksi		>5,000	

\*The test results above were obtained under standard laboratory conditions and are presented as typical material properties only. Those properties presented above are not warranted or guaranteed by Kerneos. Properties obtained from field cast specimens may result in values different than those listed above. The warranted material properties are presented in section two of this Product Data Sheet.



**MANUFACTURER:**

- KERNEOS ALUMINATE TECHNOLOGIES
- SEWPERCOAT "PG"
- OPEN

**N 4 – CONCRETE/ HIGH EARLY CONCRETE MIX:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

High early concrete mix shall meet or exceed the performance specifications of:

- Shall be used above or below grade, interior or exterior.
- High early concrete mix furnished under this specification shall be a pre-packaged product, including all cement and any required admixtures.
- It is the intent of this specification that the contractor only be required to add the proper amount of clean potable water so as to produce a concrete mix suitable for application.
- Coverage: A 60-lb. bag yields approximately 0.45 cu ft.
- An 80-lb. bag yields approximately 0.6 cu ft.
- Packaging: 60-lb. & 80-lb. bags.
- Shelf life: One year from date of manufacture.

**TECHNICAL DATA:**

- Shall have a minimum compressive strength, ASTM C-387, 1 day- 1500psi, 3 day- 2500psi, 7 day- 3500, 28 day- 5000.
- Slump range- 2"-3".



**MANUFACTURER:**

- QUIKRETE- QUIKRETE 5000 HIGH EARLY STRENGTH CONCRETE MIX #1007
- A.W. COOK CEMENT
- OPEN

**RESTRICTIONS:**

Use of this product is restricted to small nonstructural concrete repairs where truck mix is not practical and should be limited to:

- Sidewalk panel replacement.
- Curb and gutter section replacement.
- Valve box pads.

**N 5 – NON-SHRINK GROUT:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Non-shrink grout shall meet or exceed the performance specifications of:

- ASTM C928 R
- ASTM C1107
- Non-shrink, high strength, high flow material
- Shall be used above or below grade, interior or exterior.
- It is the intent of this specification that the contractor only be required to add the proper amount of clean potable water so as to produce a mix suitable for application.
- When hardened, does not shrink so it's final volume is greater than or equal to the original installed volume.
- Can be utilized in a fluid, flowable or plastic consistency. Respective compressive strengths will vary based on consistency.
- In accordance with ASTM C1107, grout shall be maintained at 70 degrees F to achieve specified performance.



**Technical Data**

Consistency	Plastic	Flowable
24 Hours	5,000 psi	4,500 psi
7 Days	6,000 psi	5,500 psi
28 Days	8,000 psi	7,500 psi

**MANUFACTURER:**


- QUIKRETE
- SIKAGROUT
- OPEN

**RESTRICTIONS:**

This product can be used for load transfers, structural repairs and reinforcing steel, to include:


- Anchor Bolts
- Reinforcing Steel
- Manhole Repairs
- Load Transfers
- Bearing Plates

<b>Section O: Structures</b>	Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<ul style="list-style-type: none"><li><a href="#">O 1    <u>Fiberglass Manholes/ Sanitary Sewer</u></a></li><li><a href="#">O 2    <u>Fiberglass Manhole Liners/ Sanitary Sewer</u></a></li><li><a href="#">O 3    <u>Fiberglass Wet Well Liners/ Sanitary Sewer</u></a></li><li><a href="#">O 4    <u>Multi-Component Stress Panel Liner System/ Sanitary Sewer</u></a></li><li><a href="#">O 5    <u>Polymorphic Resin Liner System/ Sanitary Sewer</u></a></li><li><a href="#">O 6    <u>Precast Manholes</u></a><ul style="list-style-type: none"><li><a href="#">O 6.1    <u>Precast Wet Well</u></a></li><li><a href="#">O 6.2    <u>Precast Valve Vaults</u></a></li></ul></li></ul>	

<b>O 1 – FIBERGLASS MANHOLE/ SANITARY SEWER:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Fiberglass manholes shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements specifically manufactured for use with sewage.</li> <li>• Shall be a one-piece unit.</li> <li>• Shall have no vertical seams.</li> <li>• Shall meet ASTM Standards D 3753, Fiber-glass Reinforced Polyester Manholes and Wet Wells.</li> <li>• Reinforcing material shall be Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.</li> <li>• The inter surface shall be a resin-rich layer of 0.010 to 0.020 inches thick.</li> <li>• The concentric cone section shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one-piece unit.</li> <li>• The manhole wall thickness shall not be less than 0.50 (1/2”) inches.</li> <li>• Shall provide an area for which a grade ring or brick can be installed to accept a typical metal ring &amp; cover and have strength to support a traffic load without damage to the manhole.</li> <li>• As a UV inhibitor the resin on the exterior surface shall have a color pigment added for a minimum thickness of .125 inches.</li> <li>• Stub out connections shall be made by using a fiberglass reinforced pipe stub out as a sealing surface for an approved manhole connection boot.</li> <li>• Invert and bench area can be either a noncorrosive material completely enclosed in a minimum 1/4-inch layer of fiberglass chop or concrete coated with an approved coating.</li> <li>• Shall have a minimum dynamic-load rating of 16,000 lbs. (AASHTO HS-20) when tested in accordance with ASTM D 3753 and shall not leak, crack or suffer other damage when load tested to 40,000 lbs.</li> </ul>	<p><b><u>SPECIFICATION (CONT.)</u></b></p> <ul style="list-style-type: none"> <li>• Shall meet or exceed NBS PS 15-69 physical properties as listed in table 1, of that standard:             <ul style="list-style-type: none"> <li>• Ultimate Tensile Strength (psi) 15,000</li> <li>• Flexural Strength (psi) 22,000</li> <li>• Flexural Modulus or elasticity (psi) 1,000,000</li> </ul> </li> <li>• Shall have a concrete base, 8” thick when less than 12’ deep and 12” thick when more than 12’ deep.</li> <li>• The base shall extend a minimum of 1 foot from the outside wall of the manhole.</li> <li>• The base shall be sized to act as an anti-floatation device for the entire unit.</li> <li>• Shall be sized per construction drawings.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>IDENTIFICATION:</u></b> Each manhole shall be marked inside and out with the following information:</p> <ul style="list-style-type: none"> <li>• Manufactures name and trademark</li> <li>• Manufactures factory location</li> <li>• Manufactures serial number or date code</li> <li>• Total length or nominal diameter</li> </ul>	
		

<p><b>O 1 – CONTINUED:</b></p>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"><li>• CONTAINMENT SOLUTIONS, INC.</li><li>• L.F. MANUFACTURING, INC.</li><li>• OPEN</li></ul>
<p><b><u>RESTRICTIONS:</u></b></p>	



<b>O 2 – FIBERGLASS MANHOLE LINER/ SANITARY SEWER:</b>		Effective Date: <u>01-01-20</u> Revision #: <u>2</u>
<p><b><u>SPECIFICATION:</u></b> Fiberglass manhole liners shall meet or exceed the performance specifications of:</p> <ul style="list-style-type: none"> <li>• Shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements specifically manufactured for use with sewage.</li> <li>• Shall be a one-piece unit.</li> <li>• Shall have no vertical seams.</li> <li>• Shall meet ASTM Standards D 3753, Fiber-glass Reinforced Polyester Manholes and Wet Wells.</li> <li>• Reinforcing material shall be Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.</li> <li>• The inter surface shall be a resin-rich layer of 0.010 to 0.020 inches thick.</li> <li>• The concentric cone section shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one-piece unit.</li> <li>• The liner wall thickness shall not be less than 0.50 (1/2”) inches.</li> <li>• Shall provide an area for which a grade ring or brick can be installed to accept a typical metal ring &amp; cover and have strength to support a traffic load without damage to the manhole.</li> <li>• As a UV inhibitor the resin on the exterior surface shall have a color pigment added for a minimum thickness of 0.125 inches.</li> <li>• Shall have a minimum dynamic-load rating of 16,000 lbs. (AASHTO HS-20) when tested in accordance with ASTM D 3753 and shall not leak, crack or suffer other damage when load tested to 40,000 lbs.</li> <li>• Shall meet or exceed NBS PS 15-69 physical properties as listed in table 1, of that standard:             <ul style="list-style-type: none"> <li>• Ultimate Tensile Strength (psi) 15,000</li> <li>• Flexural Strength (psi) 22,000</li> <li>• Flexural Modulus or elasticity (psi) 1,000,000</li> </ul> </li> <li>• Shall be sized per construction drawings.</li> </ul>	<p><b><u>SPECIFICATION (continued)</u></b></p> <ul style="list-style-type: none"> <li>• Pipe entering through the manhole wall with an invert equal to or higher than the bench will be sealed all around the interior wall by use of a fiberglass patch kit. There will be no exposed mortar above bench or fillet level.</li> <li>• Affidavit of compliance to this specification shall be available upon request.</li> </ul> <p><b><u>IDENTIFICATION:</u></b> Each manhole liner shall be marked inside and out with the following information:</p> <ul style="list-style-type: none"> <li>• Manufactures name and trademark</li> <li>• Manufactures factory location</li> <li>• Manufactures serial number or date code</li> <li>• Total length or nominal diameter</li> </ul>	
<p><b><u>RESTRICTIONS:</u></b></p> <ul style="list-style-type: none"> <li>• Rehabilitation only.</li> </ul>	<p><b><u>MANUFACTURER:</u></b></p> <ul style="list-style-type: none"> <li>• CONTAINMENT SOLUTIONS, INC.</li> <li>• L.F. MANUFACTURING, INC.</li> <li>• OPEN</li> </ul>	



**O 3 – FIBERGLASS WETWELL LINER/ SANITARY SEWER:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Fiberglass wet well liners shall meet or exceed the performance specifications of:

- Shall be manufactured from commercial grade polyester resin or other suitable polyester or vinylester resins with fiberglass reinforcements specifically manufactured for use with sewage.
- Shall be a one-piece unit.
- The wet good liner pipe shall have plain ends and have no vertical seams.
- Fiberglass tops and hatch openings shall be provided.
- Shall meet ASTM Standards D 3753, Fiber-glass Reinforced Polyester Manholes and Wet Wells.
- Reinforcing material shall be Grade “E” type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.
- The inter surface shall be a resin-rich layer of 0.010 to 0.020 inches thick.
- The liner wall thickness shall not be less than 0.625 (5/8”) inches.
- As a UV inhibitor the resin on the exterior surface shall have a color pigment added for a minimum thickness of 0.125 inches.
- Shall have a minimum dynamic-load rating of 16,000 lbs. (AASHTO HS-20) when tested in accordance with ASTM D 3753 and shall not leak, crack or suffer other damage when load tested to 40,000 lbs.
- Shall meet or exceed NBS PS 15-69 physical properties as listed in table 1, of that standard:
  - Ultimate Tensile Strength (psi) 15,000
  - Flexural Strength (psi) 22,000
  - Flexural Modulus or elasticity (psi) 1,000,000
- Shall be sized per construction drawings.

**SPECIFICATION (continued):**

- Pipe entering through the wet well wall with an invert equal to or higher than the bench will be sealed all around the interior wall by use of a fiberglass patch kit.
- Affidavit of compliance to this specification shall be available upon request.

**IDENTIFICATION:**

Each wet well liner shall be marked inside and out with the following information:

- Manufactures name and trademark
- Manufactures factory location
- Manufactures serial number or date code
- Total length or nominal diameter



**RESTRICTIONS:**

- Diameters of 5’ or less.

**MANUFACTURER:**

- CONTAINMENT SOLUTIONS, INC.
- L.F. MANUFACTURING, INC.
- OPEN

**O 4 – MULTI-COMPONENT STRESS PANEL LINER SYSTEM/ SANITARY SEWER:**

Effective Date: 01-01-20  
Revision #: 2

**SPECIFICATION:**

Multi-layered poly resin composite protective manhole and wet well liner system shall meet or exceed the performance specifications of:

- Shall provide a waterproof, corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater.
- Manufacture shall warrant material and workmanship for a minimum period of ten (10) years.
- Shall be a non load-bearing component.
- To ensure total unit responsibility, all material and installation shall be furnished by, and coordinated with, one supplier/ manufacturer.
- The interior surfaces to be protected shall include the walls, ceiling, benches and pipe entries.
- Total thickness of multi-component stress panel liner shall be a minimum of 500 mils and shall sustain a 300 PSI pull test.
- Use of this system is restricted to rehabilitation of existing structures.

**PHYSICAL/ MATERIAL PROPERTIES:**

1. Liner.

	<u>Installation</u>	<u>Liner</u>
Moisture barrier		Modified Polymer
Surfacer		Polyurethane/Polymeric blend foam
Final corrosion barrier		Modified polymer

2. Modified polymer shall be sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment.

**TYPICAL CHEMICAL ANALYSIS**

**“A” Component**

Viscosity, 77° F, cps., ASTM D-1638	300-400
Physical State	Liquid
Color	Clear to amber
Hygroscopicity	Reacts with water

**“B” Component**

Viscosity, 160° F, cps., ASTM D-1638	400-600
Physical State	Liquid
Color	Flamingo Pink
Non-Volatile	100%

**Reaction Profile (100 grams, 175° F sample)**

Gel Time, seconds	1-2
Tack Free Time, seconds	15
Cure Time, seconds	30

**Processing**

A System / B System, volume ratio	1.00 / 1.00
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**PHYSICAL/ MATERIAL PROPERTIES**

**(continued):**

**Typical Physical Properties**

Tensile Strength, PSI	>1500
Elongation, %	>125
Tear Strength, PSI	350
Shore D Hardness	55-65
100% Modulus, PSI	>1500

3. Polyurethane Rigid Structure Foam, low viscosity two-component, containing flame retardants.

**TYPICAL CHEMICAL ANALYSIS**

**“A” Component**

Viscosity, 77° F, cps., ASTM D-1638	200
Physical State	Liquid
Color	Dark Brown
Hygroscopicity	Reacts with water and evolves CO2 gas

**“B” Component**

Viscosity, 77° F, cps., ASTM D-1638	600-1000
Physical State	Liquid
Color	Tan
Hygroscopicity	Absorbs water rapidly thus changing ratio

**Reaction Profile (100 grams, 77° F sample)**

Cream Time, seconds	1-4
Tack Free time, seconds	5-8
Rise Time, seconds	6-10

**Processing**

A System / B System, volume ratio	1.00 / 1.00
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**Typical Physical Properties**

Density, nominal, core, lbs/ft3 ASTM D-1622 @ 74° F	4-10
Compression Strength, ASTM D-1621 @ 74° F parallel rise; PSI	90-150
Closed Cell Content, % - ASTM 1940 @ 74° F	Over 90
Shear Strength, PSI - ASTM C-273 @ 74° F	225-250



**MANUFACTURER:**

- CONCRETE CONSERVATION, INC.-
- SPECTRA-SHIELD
- OPEN

**RESTRICTIONS:**

**O 5 – POLYMORPHIC RESIN LINER SYSTEM / SANITARY SEWER:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Polymorphic resin protective manhole and wet well liner system shall meet or exceed the performance specifications of:

- Manufacture shall warrant material and workmanship for a minimum period of ten (10) years.
- Shall be a modified isphthalic polyester liner system made of two-components, 100% solid, known as polymorphic resin as described below.
- Shall provide a waterproof, corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater.
- Can be used to rehabilitate and protect concrete, steel, fiberglass, or masonry surfaces.
- System shall restore structural integrity of brick/concrete structures.
- Shall use an approved quick setting cementitious material to bring substrate to profile.
- To ensure total unit responsibility, all material and installation shall be furnished by, and coordinated with, one supplier/ manufacturer.
- The resin based material shall be used to form the sprayed on/structure enhanced monolithic liner covering all interior surfaces to be protected and shall include the walls, ceiling, benches, inverts and pipe entries.
- Application of liner system shall be in strict accordance with manufacture’s recommendation.
- The three coat system is made of a prime coat (DS-101 10-25 mils thick), intermediate coat (DS301 75-150 mils thick), and a final coat (DS-401 10-25 mils thick). Final installation shall be a minimum thickness of 150 mils and not more than 250 mils thick.

**MINIMUM PHYSICAL/ MATERIAL PROPERTIES**

Flexural Strength	ASTM D790	8,630 psi
Compressive Strength	ASTM D695	15,120 psi
Tensile Strength	ASTM D638	4,900 psi
Barcol Hardness	Impressor #L25	72-75
Adhesive Strength	Direct to Metal	1,582 psi
Adhesive Strength	Direct to Concrete	Substrate Failure



**MANUFACTURER:**

- ZEBRON 386
- OPEN

**RESTRICTIONS:**

**O 6 – PRECAST MANHOLES:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

- Precast manhole shall meet or exceed the performance specifications of ASTM C478 & C913 for round structures.
- Openings shall be manufactured per ASTM C76, coring shall be specified per plans.
- Structure to be watertight and resist buoyant force.
- Standard manhole precast riser sections shall not exceed 4-feet; larger pump station wet well sections may be approved.
- Concrete shall conform to:
  - Compressive strength 4,000 psi @ 28-days
  - Air content 4% min.
  - Aggregate: ASTM C33
  - Cementitious materials: minimum of 564 lbs./yd<sup>3</sup>.
  - Free of organic impurities.
- Manholes 4-feet deep or less shall have an eccentric cone or a flat top.
- Manholes over 4-feet deep shall have an eccentric cone.
- Manholes shall have a minimum inside diameter of 4-feet for sewer mains 12-inches and smaller.
- Manholes shall be 5-feet for sewer mains larger than 12-inches.
- 5-foot manholes shall have an 8" extended base.
- 4-foot manholes shall have a 6" extended base.
- Extended bases shall have a minimum thickness of 6-inches.
- Manholes at ground level and located in traffic areas shall have anti-inflow inserts per Section K.
- Lift and handling devices shall have safety factor of 4 or greater.
- Corrosion linings as specified and indicated on design drawings.

**SPECIFICATION (continued):**

- Vents in remote or outfall areas shall be constructed of aluminum or 316 SST and shall extend a minimum of 2-feet above 100-year flood with integral non-corrosive insect screen.
- Vents in residential neighborhoods and commercial areas require special approval on a case-by-case basis.
- Watertight joints using ASTM C990 preformed flexible sealants.
- Pipe to manhole connections shall conform to ASTM C923 per Section H.
- Cylindrical wall seals per Section K.
- The location of the pipe connectors shall vary from the plans no more than ½-inch vertically and 5-degrees horizontally.



**MANUFACTURES:**

- OLD CASTLE
- TINDALL
- STAY-RIGHT
- CAPE FEAR PRECAST
- OPEN

**RESTRICTIONS:**

**O 6.1 – PRECAST WET WELL:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Precast wet wells for pump stations shall meet or exceed the preceding performance specifications of precast manhole with supplemental requirements as indicated below:

- Concrete 5,000 psi compressive strength @ 28-days.
- Minimum wall thickness shall be 5" for 5'-0", 6" for 6'-0" and 8" for 8'-0".
- Provide 1-inch cover all reinforcing steel.
- Base section shall include a 1'-0" extended base unless otherwise specified.
- All fasteners, wedge anchors, bolts, and hooks shall be 316 stainless steel.
- Support grip for each float and dower cord shall be "Hubbell" closed mesh series 024-17-xxx.
- Raintight aluminum hatch per design drawings, lockable with matching eye and padlock per Section I.
- Top shall be set as minimum of 2' above 100-year flood EL.
- Subject to leakage testing requirements per specifications.



• **MANUFACTURES:**

- OLD CASTLE
- TINDALL
- STAY-RIGHT
- CAPE FEAR PRECAST
- OPEN

**RESTRICTIONS:**



**O 6.2 – PRECAST VAULTS:**

Effective Date: 01-01-20  
 Revision #: 2

**SPECIFICATION:**

Precast concrete valve vaults shall meet or exceed the preceding requirements for precast manholes and with supplement requirements as indicated below:

- Conform to ASTM C913 & C890 for rectangular/square structures.
- Minimum 4' x 4' x 4' with a minimum base thickness of 6" and minimum wall thickness of 5".
- Live load rating of AASHTO HS20-44.
- Access hatches shall be pad lockable frame and cover, with a 1/4" watertight aluminum plate and 1/8" thick x 3" wide 316 stainless steel hinges per Section I.
- Step to be installed 18" below hatch on a non-hinged side.
- Shall be watertight structure. Subject to leakage testing requirements per specifications.



**MANUFACTURES:**

- OLD CASTLE
- TINDALL
- STAY-RIGHT
- CAPE FEAR PRECAST
- OPEN

**RESTRICTIONS:**