

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS

- A. Drawings and Division 00 and 01, apply to this Section.

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Single-wall piping.
  - 2. Double-containment piping.
  - 3. Field-fabrication containment piping.
  - 4. Piping specialties.
  - 5. Neutralization tanks.
  - 6. Neutralization systems.
  - 7. Leak-detection systems.

### 1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.

### 1.4 CODES AND STANDARDS

- A. Codes and Standards shall be the current version adopted by the Authority Having Jurisdiction.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Single-Wall Piping Pressure Rating: [10 feet head of water] <Insert pressure>.
- B. Double-Containment Piping Pressure Rating:
  - 1. Carrier Piping: [5-psig] <Insert pressure> air test pressure.
  - 2. Containment Piping: [5-psig] <Insert pressure> air test pressure.
- C. Field-Fabrication Containment-Piping Pressure Rating: [5-psig] <Insert pressure> air test pressure.

### 1.6 SUBMITTALS

- A. General: See Division 23 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.
- B. Product Data: Provided submittals of the following:
  - 1. Piping and fittings.
  - 2. Piping specialties.
  - 3. Neutralization tank and systems.
  - 4. Leak-detection systems.

- C. Shop Drawings: In addition to requirements set forth in Division 23, shop drawings for the listed systems shall also include detailing of pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops. Provide submittals of the following piping systems [within mechanical equipment rooms] [within the entire building]:
  - 1. Neutralization system and leak-detection system.
- D. Reports and Certificates: Provide submittals of the following:
  - 1. Qualification Data: For qualified Installer.
  - 2. Field quality-control reports.

#### 1.7 QUALITY ASSURANCE

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

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, fittings, and seals from dirt and damage.

#### 1.9 PROJECT CONDITIONS

- A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:
  - 1. Notify [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of chemical-waste service.
  - 2. Do not proceed with interruption of chemical-waste service without [Architect's] [Construction Manager's] [Owner's] written permission.

#### 1.10 COORDINATION

- A. Coordinate sizes and locations of concrete housekeeping pads with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.11 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. Neutralization-Tank Limestone: Equal to [200] <Insert number> percent of amount required for each tank sump initial charge. Furnish limestone in 50-lb bags.
  - 2. Neutralization-System Limestone and Chemicals: For each neutralization system.

- a. Limestone: Equal to [500] <Insert number> percent of amount required for tank sump initial charge. Furnish limestone in 50-lb bags.
- b. Chemicals: Equal to [500] [1000] <Insert number> percent of neutralizing chemicals required for filling tanks.

## PART 2 – PRODUCTS

### 2.1 SINGLE-WALL PIPE AND FITTINGS

- A. PE Drainage Pipe and Fittings: Made of ASTM D 4976, PE resin.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ISCO Industries, LLC.
    - b. Performance Pipe; a division of Chevron Phillips Chemical Company LLC.
    - c. PolyPipe, Inc. Div.; Rinker Materials Corporation.
    - d. Or Approved Equal.
  2. Pipe: ASTM F 1412, Schedule 40.
  3. Fittings: ASTM F 1412, Schedule 40, socket-fusion, drainage pattern complying with ASTM D 3311.
- B. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with [fusion] [fusion- and mechanical] [mechanical]-joint ends.
  1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. IPEX Inc.
    - b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
    - c. Sloane, George Fischer Inc.
    - d. Town & Country Plastics, Inc.
    - e. Watts Industries (Canada) Inc.
    - f. Zurn Plumbing Products Group; Chemical Drainage Systems.
    - g. Or Approved Equal.
- C. PVC Drainage Pipe and Fittings: ASTM D 2665, pipe and drainage-pattern fittings.
- D. PVDF Drainage Pipe and Fittings: ASTM F 1673, Schedule 40, pipe and drainage-pattern fittings. Include fittings with [fusion] [fusion- and mechanical] [mechanical]-joint ends.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
    - b. Watts Industries (Canada) Inc.
    - c. Zurn Plumbing Products Group; Chemical Drainage Systems.
    - d. Or Approved Equal.

- E. Fiberglass Pipe and Fittings, Centrifugally Cast: ASTM D 2997, Type II, [Grade 1] [Grade 2] <Insert grade>, [Class A] [Class B] [Class C], RTRP pipe; with ASTM D 5685, Type 4, RTRF fittings matching pipe; and [adhesive-bonding] [adhesive-bonding and butt-and-wrap-joint] [butt-and-wrap-joint] materials. Include wall thickness that will provide [160-psig] <Insert value> minimum, sustained water test pressure rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Smith Fibercast.
    - b. Or Approved Equal.
- F. Fiberglass Pipe and Fittings, Filament Wound: ASTM D 2996, Type I, [Grade 1] [Grade 2] <Insert grade>, [Class A] [Class B] [Class C] [Class E] [Class F] <Insert class>, RTRP pipe; ASTM D 5685, Type 1, RTRF fittings matching pipe; and [adhesive-bonding] [adhesive-bonding and butt-and-wrap-joint] [butt-and-wrap-joint] materials. Include wall thickness that will provide [160-psig] <Insert value> minimum, sustained water test pressure rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ameron International; Fiberglass Pipe Group.
    - b. Fibrex.
    - c. Smith Fibercast.
    - d. Or Approved Equal.
- G. High-Silicon-Iron, Hub-and-Plain-End Pipe and Fittings: ASTM A 861, pipe and drainage-pattern fittings; acid-resistant packing; and lead calking materials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve Corporation; Foundry Operations.
    - b. Or Approved Equal.
- H. High-Silicon-Iron, Mechanical-Joint Pipe and Fittings: ASTM A 861, pipe and drainage-pattern fittings; and stainless-steel clamps with TFE inner sleeve and CR outer sleeve.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve Corporation; Foundry Operations.
    - b. Or Approved Equal.
- I. Stainless-Steel Drainage Pipe and Fittings: ASME A112.3.1, ASTM A 666, Type 316L, stainless-steel pipe and drainage-pattern fittings; with socket and spigot ends for gasket joints; and having piping manufacturer's FPM lip-seal rubber gaskets shaped to fit socket groove, with plastic backup ring.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Blucher-Josam Div.

- b. Or Approved Equal.
- J. Borosilicate Glass Pipe and Fittings: ASTM C 1053, pipe and drainage-pattern fittings; with manufacturer's standard couplings.
- K. Covering: Factory-applied polystyrene for pipe installed underground.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. SCHOTT Corporation.
    - b. Or Approved Equal.
- L. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

## 2.2 DOUBLE-CONTAINMENT PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ameron International; Fiberglass Pipe Group.
  - 2. Asahi/America.
  - 3. Eslon Thermoplastics; Guardian Div.
  - 4. Fischer, George Inc.
  - 5. Flo Safe, Inc.
  - 6. Insul-Tek Piping Systems, Inc.
  - 7. IPEX Inc.
  - 8. IPEX Inc.; Guardian Div.
  - 9. NIBCO INC.
  - 10. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
  - 11. Performance Pipe; a division of Chevron Phillips Chemical Company LLC.
  - 12. Rovanco Piping Systems, Inc.
  - 13. Smith Fibercast.
  - 14. Thermacor Process, L.P.
  - 15. Or Approved Equal.
- B. Description: Factory-fabricated, double-wall pipe and fittings. Sizes indicate carrier-pipe size; with carrier (inner) pipe and fittings; annular-space, carrier-pipe supports; containment (outer) pipe and fittings; and joining materials and fasteners. Include manufacturer's standard piping materials according to the following:
  - 1. PE, Double-Containment Drainage Pipe and Fittings: Made of ASTM D 4976, PE resin.
    - a. Carrier and Containment Pipes: ASTM F 1412, Schedule 40.
    - b. Fittings: ASTM F 1412, Schedule 40 drainage pattern complying with ASTM D 3311.
  - 2. PP, Double-Containment Drainage Pipe and Fittings: Made of ASTM D 4101, PP resin.

- a. Carrier and Containment Pipes: ASTM F 1412, Schedule 40.
  - b. Fittings: ASTM F 1412, Schedule 40 drainage pattern complying with ASTM D 3311.
3. PP/PVC, Double-Containment Drainage Pipe and Fittings:
    - a. PP Carrier Pipe: ASTM F 1412, Schedule 40; made of ASTM D 4101, PP resin.
    - b. PP Carrier-Pipe Fittings: ASTM F 1412, Schedule 40 drainage pattern complying with ASTM D 3311; made of ASTM D 4101, PP resin.
    - c. PVC Containment Pipe: ASTM D 2665, PVC pipe.
    - d. PVC Containment Pipe Fittings: ASTM D 2665, PVC drainage pattern.
  4. PVDF, Double-Containment Drainage Pipe and Fittings: Made of ASTM D 3222, PVDF resin.
    - a. Carrier and Containment Pipes: ASTM F 1673, Schedule 40.
    - b. Fittings: ASTM F 1673, Schedule 40 drainage pattern complying with ASTM D 3311.
  5. PVDF/PVC, Double-Containment Drainage Pipe and Fittings:
    - a. PVDF Carrier Pipe: ASTM F 1673, Schedule 40; made of ASTM D 3222, PVDF resin.
    - b. PVDF Carrier-Pipe Fittings: ASTM F 1673, Schedule 40 drainage pattern complying with ASTM D 3311; made of ASTM D 3222, PVDF resin.
    - c. PVC Containment Pipe: ASTM D 2665, PVC pipe.
    - d. PVC Containment Pipe Fittings: ASTM D 2665, PVC drainage pattern.
- C. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

### 2.3 FIELD-FABRICATION CONTAINMENT PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flo Safe, Inc.
  2. Sloane, George Fischer Inc.
  3. Or Approved Equal.
- B. Description: Containment split pipe and split fittings with carrier-pipe centralizers. Include manufacturer's fastening devices and materials.
1. Material: [HDPE] [PP] [Yellow PVC] [Clear PVC] pipe and fittings.
  2. Fastening System: FPM gaskets, clamps, and pins.
  3. Material: Clear PVC pipe and fittings with adhesive channels, for use with drainage-pattern carrier piping.
  4. Fastening System: Adhesive.

### 2.4 JOINING MATERIALS

- A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.
- C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.
- D. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- E. Fiberglass-Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.5 PIPING SPECIALTIES

- A. Plastic Dilution Traps:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. IPEX Inc.
    - b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
    - c. Sloane, George Fischer Inc.
    - d. Town & Country Plastics, Inc.
    - e. Or Approved Equal.
  - 2. Material: Corrosion-resistant PP, with removable base.
  - 3. End Connections: Mechanical joint.
  - 4. Dilution Tanks: 1-gal. capacity, with clear base unless colored base is indicated; with two NPS 1-1/2 top inlets and one NPS 1-1/2 side outlet.
  - 5. Small Dilution Jars: 1-pint capacity, with clear base unless colored base is indicated; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.
  - 6. Large Dilution Jars: 1-quart capacity; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.
- B. High-Silicon-Iron Dilution Traps:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve Corporation; Foundry Operations.
    - b. Or Approved Equal.
  - 2. Standard: ASTM A 861.
  - 3. Size: NPS 1-1/2 or NPS 2 as required for fixture and waste.
  - 4. End Connections: Mechanical.
- C. Glass, Drain-Line, Interceptor Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. SCHOTT Corporation.
    - b. Or Approved Equal.
  2. Standard: ASTM C 1053.
  3. Type: Drum trap.
  4. Size: NPS 1-1/2, NPS 2 by NPS 1-1/2, or NPS 2, as required to match connecting piping.
- D. Corrosion-Resistant Traps:
1. Type: P-trap or drum trap.
  2. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
  3. High-Silicon Iron: ASTM A 861, with horizontal outlet and hub-and-plain or plain ends to match connecting piping.
  4. PP: ASTM D 4101, with mechanical-joint pipe connections.
  5. PVDF: ASTM D 3222, with mechanical-joint pipe connections.
  6. Glass: ASTM C 1053, with coupling pipe connections.
- E. High-Silicon-Iron Floor Drains <Insert drawing designation>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve Corporation; Foundry Operations.
    - b. Or Approved Equal.
  2. Standard: ASTM A 861.
  3. Body: With integral flashing flange and weep holes; and with [flashing ring and stainless-steel strip] [sediment basin] [and] [funnel attachment].
  4. Top: 8-3/4-inch diameter with grate.
  5. Size: NPS 2, NPS 3, NPS 4, or NPS 6 outlet as indicated.
- F. Stainless-Steel Floor Drains <Insert drawing designation>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Blucher-Josam Div.
    - b. Or Approved Equal.
  2. Standard: ASME A112.3.1, ASTM A 666, Type 316L.
  3. Body: With [8.5-by-8.5-inch] [12.4-by-12.4-inch] top with grate.
  4. Outlet: Bottom, of size indicated.
- G. PP Floor Drains <Insert drawing designation>:
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. IPEX Inc.
  - b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
  - c. Schier Products Company.
  - d. Sloane, George Fischer Inc.
  - e. Town & Country Plastics, Inc.
  - f. Watts Industries (Canada) Inc.
  - g. Or Approved Equal.
2. Body: With 7- to 9-inch top diameter, with flashing flange and weep holes; and with [flashing clamp] [basket strainer] [funnel attachment] [and] [trap-primer connection].
  3. Outlet: Bottom, to match connecting pipe, with NPS 2, NPS 3, NPS 4, or NPS 6 outlet as indicated.
- H. High-Silicon-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve Corporation; Foundry Operations.
    - b. Or Approved Equal.
  2. Standard: ASTM A 861, fitting with PTFE gasket and closure plug, of design appropriate for piping application.
- I. Stainless-Steel Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Blucher-Josam Div.
    - b. Or Approved Equal.
  2. Standard: ASME A112.3.1, ASTM A 666, Type 316L, stainless steel.
  3. Aboveground Piping: Cleanout tee of size matching piping.
  4. Underground and Underslab Piping: Floor access cleanout of size matching piping.
- J. High-Silicon-Iron Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve Corporation; Foundry Operations.
    - b. Or Approved Equal.
  2. Standard: ASTM A 861.
  3. Body: Hub-and-plain end with swing-check valve [; and with high-silicon-iron pipe extension of length to reach floor surface, and high-silicon-iron closure plug.]
- K. Plastic Backwater Valves:
1. Description: Full-port NPS 3 check valve, PP or PVDF, matching or compatible with system piping and compatible with system liquid, with EPDM seals and flanged ends.

- a. Exception: PVC material for use with PVC piping systems.

L. High-Silicon-Iron Sink Outlets:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flowserve Corporation; Foundry Operations.
  - b. Or Approved Equal.
- 2. Standard: ASTM A 861, high-silicon iron, NPS 1-1/2, with clamping device and 4-, 6-, or 8-inch-high overflow fitting, as indicated.

M. PP Sink Outlets:

- 1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch- high overflow fitting.

N. Glass Sink Outlets:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. SCHOTT Corporation.
  - b. Or Approved Equal.
- 2. Standard: ASTM C 1053, components for field assembly, NPS 1-1/2; with sink assembly of outlet, strainer, gasket, and locknut; overflow fitting of length indicated; and tailpiece assembly of borosilicate glass and locknut.

## 2.6 NEUTRALIZATION TANKS

A. Plastic Neutralization Tanks <Insert drawing designation>:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chem-Tainer Industries.
  - b. IPEX Inc.
  - c. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
  - d. Schier Products Company.
  - e. Sloane, George Fischer Inc.
  - f. Town & Country Plastics, Inc.
  - g. Watts Industries (Canada) Inc.
  - h. Or Approved Equal.
- 2. Description: Corrosion-resistant plastic materials; with removable, gastight cover; interior, sidewall, dip-tube inlet; outlet; vent; and threaded or flanged, sidewall pipe connections.
  - a. Material: [HDPE] [HDPE or ASTM D 4101, PP] [ASTM D 4101, PP].
  - b. Tank Capacity: <Insert capacity>.
  - c. Dip Tube: On outlet pipe instead of inlet pipe.

- d. Extension: HDPE, PE, or PP.
- e. Traffic Cover: [Light-duty] [Heavy-duty pedestrian or light-duty vehicular, steel plate over] plastic, bolted.
- f. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
- g. Dolomitic Limestone: Chips or lumps, with more than 90 percent combined magnesium carbonate and calcium carbonate content and 1- to 3-inch diameter.

B. Ceramic Neutralization Tanks <Insert drawing designation>:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Koch Knight LLC.
  - b. Or Approved Equal.
- 2. Description: Corrosion-resistant, cast-ceramic shell; with removable, reinforced-plastic, gastight cover; inlet; interior, sidewall, dip-tube outlet; vent; and bell, sidewall pipe connections.
  - a. Tank Capacity: <Insert capacity>.
  - b. Extension: Ceramic, of size and length indicated, and with cast-iron manhole frame and cover.
  - c. Extension: Steel with protective coating, 28-inch diameter, and cast-iron manhole frame and cover.
  - d. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
  - e. Dolomitic Limestone: Chips or lumps, with more than 90 percent combined magnesium carbonate and calcium carbonate content and 1- to 3-inch diameter.

C. Collection Tanks: Corrosion-resistant, cast-ceramic shell. Include removable, reinforced-plastic, gastight cover; inlet; vent; and bell, sidewall pipe connections.

- 1. Extension: [Ceramic] [Steel with protective coating], 28-inch minimum diameter, and cast-iron manhole frame and cover.

## 2.7 NEUTRALIZATION SYSTEMS

A. Plastic-Tank Neutralization Systems <Insert drawing designation>:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
  - b. Town & Country Plastics, Inc.
  - c. Or Approved Equal.
- 2. Description: Automatic system for neutralizing chemical waste.
  - a. Controls: Factory-wired and -tested, 120-V ac, to operate probes, control valves, and metering pumps and to monitor pH of effluent; with wiring and electrical-power terminals.

- b. Panel: NEMA 250, Type 4X enclosure, unless otherwise indicated; with manufacturer's standard features, control devices, and indicators, but not less than the following:
    - 1) Power light and on/off switch.
    - 2) pH analyzer with meter and high- and low-pH indicators.
    - 3) Low caustic- and acid-solution level indicators.
    - 4) Alarm horn with silencer and reset switch.
    - 5) Agitator running light with on/off switch.
    - 6) Running lights with on/off switches for caustic- and acid-solution pumps.
  - c. Strip chart recorder with capacity for 30-day record.
  - d. Piping between Tanks: Same material as chemical-waste piping system unless otherwise indicated.
  - e. Interceptor Tank: Same material as mixing tank; with removable, gastight cover; and sidewall inlet and outlet piping connections.
  - f. Neutralization Tank: Same material as mixing tank; with removable, gastight cover; sidewall inlet and outlet piping connections; and vent connection in sidewall or top.
    - 1) Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
    - 2) Dolomitic Limestone: Chips or lumps, with more than 90 percent combined magnesium carbonate and calcium carbonate content and 1- to 3-inch diameter.
  - g. Mixing Tank: With removable, gastight cover; sidewall inlet and outlet piping connections; vent connection in sidewall or top; neutralizing-solution piping connections; and openings in top for probe and agitator.
    - 1) Material: [HDPE] [HDPE or ASTM D 4101, PP] [ASTM D 4101, PP].
    - 2) pH Probe: Type and length suitable for mixing-tank size.
    - 3) Agitator: Electric, with stainless-steel shaft and propeller.
  - h. Caustic-Solution Storage Tank: PP.
    - 1) Caustic Chemical: Sodium hydroxide solution.
  - i. Acid Storage Tank: PP.
    - 1) Acid Chemical: Sulfuric acid solution.
  - j. Metering Pumps: Types suitable for neutralizing solutions.
  - k. Sampling Tank: Same material as mixing tank; with removable, gastight cover; sidewall inlet and outlet piping connections; and opening in top for probe.
    - 1) pH probe: Type and length suitable for sampling-tank size.
- B. Ceramic-Tank Neutralization Systems <Insert drawing designation>:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Koch Knight LLC.
  - b. Or Approved Equal.
2. Description: Automatic system for neutralizing chemical waste.
- a. Controls: Factory-wired and -tested, 120-V ac, to operate probes, control valves, and metering pumps and to monitor pH of effluent; with wiring and electrical-power terminals.
  - b. Panel: NEMA 250, Type 4X enclosure, unless otherwise indicated; with manufacturer's standard features, control devices, and indicators, including the following:
    - 1) Power light and on/off switch.
    - 2) pH analyzer with meter and high- and low-pH indicators.
    - 3) Low caustic- and acid-solution level indicators.
    - 4) Alarm horn with silencer and reset switch.
    - 5) Agitator running light with on/off switch.
    - 6) Running lights with on/off switches for caustic- and acid-solution pumps.
  - c. Strip chart recorder with capacity for 30-day record.
  - d. Piping between Tanks: Same material as chemical-waste piping system unless otherwise indicated.
  - e. Interceptor Tank: Same material as mixing tank; with removable, gastight cover; and sidewall inlet and outlet piping connections.
  - f. Neutralization Tank: Same material as mixing tank; with removable, gastight cover; sidewall inlet and outlet piping connections; and vent connection in sidewall or top.
    - 1) Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
    - 2) Dolomitic Limestone: Chips or lumps, with more than 90 percent combined magnesium carbonate and calcium carbonate content and 1- to 3-inch diameter.
  - g. Mixing Tank: With removable, gastight cover; sidewall inlet and outlet piping connections; vent connection in sidewall or top; neutralizing-solution piping connections; and openings in top for probe and agitator.
    - 1) Material: Clay, vitrified into ceramic unit.
    - 2) pH Probe: Type and length suitable for mixing tank size.
    - 3) Agitator: Electric, with stainless-steel shaft and propeller.
  - h. Caustic-Solution Storage Tank: PP.
    - 1) Caustic Chemical: Sodium hydroxide solution.
  - i. Acid Storage Tank: PP.
    - 1) Acid Chemical: Sulfuric acid solution.
  - j. Metering Pumps: Types suitable for neutralizing solutions.
  - k. Sampling Tank: Same material as mixing tank; with removable, gastight cover; sidewall inlet and outlet piping connections; and opening in top for probe.

- 1) pH probe: Type and length suitable for sampling-tank size.

## 2.8 LEAK-DETECTION SYSTEMS

### A. Leak-Detection Systems <Insert drawing designation>:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Asahi/America.
  - b. Flo Safe, Inc.
  - c. Perma-Pipe, Inc.; Subsidiary of MFRI, Inc.
  - d. Tyco Thermal Controls LLC; Tracer Div.
  - e. Or Approved Equal.
2. Description: Cable leak-detection system capable of detecting and annunciating fluid leaks; with controls, panel, wiring, cable sensors, probes if required, and piping.
  - a. Annunciator Panel: Enclosure with visual and audible alarms and leak location indicator.
  - b. Sensors: Electric cable, suitable for insertion into double-containment piping annular space, with capability of detecting fluid leaks and signaling locations of leaks.

## 2.9 SLEEVES

- A. Comply with requirements in Division 23, "Common Mechanical Materials and Methods."

## 2.10 SLEEVE SEALS

- A. Comply with requirements in Division 23, "Common Mechanical Materials and Methods."

## 2.11 ESCUTCHEONS

- A. Comply with requirements in Division 23, "Common Mechanical Materials and Methods."

## 2.12 GROUT

- A. Comply with requirements in Division 23, "Common Mechanical Materials and Methods."

## PART 3 – EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 CONCRETE HOUSEKEEPING PADS

- A. Anchor [neutralization tanks] [and] [neutralization system tanks] to concrete housekeeping pads.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Construct concrete housekeeping pads of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
6. Use [3000-psi] <Insert value>, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]."

B. Comply with requirements in Division 03 for cast-in-place concrete materials and placement.

### 3.3 PIPING INSTALLATION

A. Chemical-Waste Piping Inside the Building:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install underground fiberglass piping according to ASTM D 3839.
5. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
6. 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.
7. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
8. Install piping at indicated slopes.
9. Install piping free of sags and bends.
10. Install fittings for changes in direction and branch connections.
11. Install escutcheons for penetrations of walls, ceilings, and floors as required in Division 23.

### 3.4 PIPING SPECIALTY INSTALLATION

- A. Embed floor drains in 4-inch minimum depth of concrete around bottom and sides. Comply with requirements in Division 03 Section for concrete.
- B. Fasten grates to drains if indicated.
- C. Set floor drains with tops flush with pavement surface.
- D. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement with tops flush with pavement surface. Comply with requirements in Division 03 Section for formwork, reinforcement, and concrete requirements.
- E. Install backwater valves in horizontal position. Include riser to cleanout at grade.

### 3.5 JOINT CONSTRUCTION

A. Chemical-Waste Piping Inside the Building:

1. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
2. Fiberglass-Piping Joints: Make joints with piping manufacturer's bonded adhesive.
3. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.
4. Join high-silicon-iron, hub-and-plain-end piping with calked joints using acid-resistant packing and lead.
5. Join high-silicon-iron, mechanical-joint piping with coupled joints using clamps and sleeves.
6. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe sizes in this article refer to aboveground, single-wall piping [and carrier piping of containment piping].
- B. Comply with requirements in Division 23 for seismic-restraint devices.
- C. Comply with requirements in Division 23 for pipe hanger and support devices. Install the following:
1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- D. Comply with requirements in Division 23 for installation of supports.
- E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- F. Support vertical piping and tubing at base and at each floor.
- G. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.
- H. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 33 inches with 3/8-inch rod.
  2. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  4. NPS 6: 48 inches with 3/4-inch rod.
  5. NPS 8: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PP piping every 72 inches.
- J. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 36 inches with 3/8-inch rod.
  2. NPS 1-1/2 and NPS 2: 42 inches with 3/8-inch rod.
  3. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
  4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  5. NPS 6: 48 inches with 3/4-inch rod.
  6. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- K. Install supports for vertical PVC piping every 48 inches.
- L. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:
1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.
  2. NPS 1/2 and Smaller: 30 inches with 3/8-inch rod.
  3. NPS 3/4 to NPS 1-1/2: 36 inches with 3/8-inch rod.
  4. NPS 2: 36 inches with 3/8-inch rod.
  5. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
  6. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  7. NPS 6: 48 inches with 3/4-inch rod.
- M. Install supports for vertical PVDF piping NPS 1-1/2 every 48 inches and NPS 2 and larger every 72 inches.
- N. Install vinyl-coated hangers for fiberglass piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 and Smaller: 10 feet with 3/8-inch rod.
  2. NPS 2-1/2 and NPS 3: 10 feet with 1/2-inch rod.
  3. NPS 4 and NPS 5: 10 feet with 5/8-inch rod.
  4. NPS 6: 10 feet with 3/4-inch rod.
  5. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- O. Install supports for vertical fiberglass piping every 12 feet.
- P. Install hangers for stainless-steel drainage piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2: 10 feet with 3/8-inch rod.
  2. NPS 2-1/2: 11 feet with 1/2-inch rod.
  3. NPS 3: 12 feet with 1/2-inch rod.
  4. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

5. NPS 6: 12 feet with 3/4-inch rod.
- Q. Install supports for vertical stainless-steel drainage piping every 15 feet.
- R. Install hangers for high-silicon-iron piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6: 60 inches with 3/4-inch rod.
  5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
  6. NPS 15: 60 inches with 1-inch rod.
  7. Spacing for horizontal pipe in 84-inch lengths may be increased to 84 inches. Spacing for fittings is limited to 60 inches.
- S. Install supports for vertical high-silicon-iron piping every 15 feet.
- T. Install vinyl-coated hangers for glass piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  3. NPS 3: 96 inches with 1/2-inch rod.
  4. NPS 4 and NPS 6: 96 inches with 5/8-inch rod.
- U. Install supports for vertical glass piping every 96 inches.
- V. Support piping and tubing not listed above according to MSS SP-69.

### 3.7 NEUTRALIZATION TANK INSTALLATION

- A. Install exterior [collection] [collection and neutralization] [neutralization] tanks, complete with appurtenances indicated.
  1. Set tops of tank covers flush with finished surface where covers occur in pavements. Set covers 3 inches above finished surface elsewhere unless otherwise indicated.
  2. Include initial fill of limestone for neutralization tanks.
- B. Install interior neutralization tanks on smooth and level [concrete base] [floor surface]. Include full initial charge of limestone.

### 3.8 NEUTRALIZATION SYSTEM INSTALLATION

- A. Install neutralization systems on smooth and level [concrete base] [floor surface]. Include neutralizing solutions and full initial charge of limestone.

### 3.9 LEAK-DETECTION SYSTEM INSTALLATION

- A. Single-Pipe, Chemical-Waste Sewerage Piping: Install leak-detection system below piping.
- B. Double-Containment Piping: Install leak-detection system in piping annular space.

- C. Manholes: Install leak-detection system around bottom of exterior.
- D. Install panel in location indicated.

### 3.10 CONCRETE PLACEMENT

- A. Comply with requirements in Division 03 for concrete supports.
- B. Place cast-in-place concrete according to ACI 318/318R.

### 3.11 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.
- C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of [3000 psi] <Insert value>.
- D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
- E. Install piping adjacent to equipment to allow service and maintenance.

### 3.12 LABELING AND IDENTIFICATION

- A. Comply with requirements in Division 23 for labeling of equipment and piping.
  - 1. Use [warning tape or] detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.13 FIELD QUALITY CONTROL

- A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.
  - 1. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Hydrostatic Tests for Drainage Piping:
      - 1) Allowable leakage is a maximum of [50 gal./inch of nominal pipe size per mile] <Insert value> of pipe, during 24-hour period.
      - 2) Close openings in system and fill with water.

- 3) Purge air and refill with water.
      - 4) Disconnect water supply.
    - e. Test and inspect joints for leaks.
  2. Air Tests for Drainage Piping: Comply with UNI-B-6.
  3. Leaks and loss in test pressure constitute defects that must be repaired.
  4. Submit separate reports for each test.
- B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. 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.
- E. Tests and Inspections:
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect assembled [neutralization systems] [and] [leak-detection systems] and their installation, including piping and electrical connections, and to assist in testing.
  2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Chemical-waste piping will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.14 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service for [neutralization systems] [and] [leak-detection systems].
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Neutralization Systems:
    - a. Verify that neutralization system is installed and connected according to the Contract Documents.
    - b. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.
    - c. Install neutralizing solutions and limestone.
    - d. Energize circuits.
    - e. Start and run systems through complete sequence of operations.
    - f. Adjust operating controls.

g. <Insert startup steps if any>.

3. Leak-Detection Systems:

- a. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.
- b. Energize circuits.
- c. Adjust operating controls.
- d. <Insert startup steps if any>.

3.15 ADJUSTING

- A. Adjust neutralization-system set points.
- B. Adjust leak-detection-system control and device settings.

3.16 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Clean piping by flushing with potable water.

3.17 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain [neutralization systems] [and] [leak-detection systems].

3.18 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.
- B. Single-Wall, Chemical-Waste Sewerage Piping: Use [ any of] the following piping materials for each size range:
  1. NPS 2 to NPS 4: [High-silicon-iron, hub-and-plain-end pipe and fittings and calked] [High-silicon-iron, mechanical-joint pipe and fittings and coupled] joints.
  2. NPS 2 to NPS 4: Stainless-steel drainage pipe and fittings and gasketed joints.
  3. NPS 1-1/2 to NPS 4: PE drainage pipe and fittings and heat-fusion joints.
  4. NPS 1-1/2 to NPS 4: PP drainage pipe and fittings and electrofusion joints.
  5. NPS 1-1/2 to NPS 4: PVC drainage pipe and fittings and solvent-cemented joints.
  6. NPS 1-1/2 to NPS 4: PVDF drainage pipe and fittings and electrofusion joints.
  7. NPS 2 to NPS 4: [Centrifugally cast] [Filament-wound] fiberglass pipe and fittings and [butt-and-wrap] [bonded] joints.
  8. NPS 1-1/2 to NPS 4: Glass pipe and fittings and coupled joints.
  9. NPS 6: [High-silicon-iron, hub-and-plain-end pipe and fittings and calked] [High-silicon-iron, mechanical-joint pipe and fittings and coupled] joints.
  10. NPS 6: Stainless-steel drainage pipe and fittings and gasketed joints.
  11. NPS 6: PE drainage pipe and fittings and heat-fusion joints.
  12. NPS 6: PP drainage pipe and fittings and electrofusion joints.

13. NPS 6: PVC drainage pipe and fittings and solvent-cemented joints.
  14. NPS 6: PVDF drainage pipe and fittings and electrofusion joints.
  15. NPS 6: [Centrifugally cast] [Filament-wound] fiberglass pipe and fittings and [butt-and-wrap] [bonded] joints.
  16. NPS 6: Glass pipe and fittings and coupled joints.
  17. NPS 8 to NPS 12: High-silicon-iron, hub-and-plain-end pipe and fittings and calked joints.
  18. NPS 8 to NPS 12: PP drainage pipe and fittings and electrofusion joints.
  19. NPS 8 to NPS 12: PVC drainage pipe and fittings and solvent-cemented joints.
  20. NPS 8 to NPS 12: PVDF drainage pipe and fittings and electrofusion joints.
  21. NPS 8 to NPS 12: [Centrifugally cast] [Filament-wound] fiberglass pipe and fittings and [butt-and-wrap] [bonded] joints.
  22. NPS 15: High-silicon-iron, hub-and-plain-end pipe and fittings and calked joints.
  23. NPS 15: [NPS 16 centrifugally cast] [NPS 14 filament-wound] fiberglass pipe and fittings and [butt-and-wrap] [bonded] joints.
- C. Underground, Double-Containment, Chemical-Waste Sewerage Piping: Use [ any of] the following piping materials for each size range:
1. NPS 2 to NPS 12: PE double-containment drainage pipe and fittings.
  2. NPS 2 to NPS 12: PP double-containment drainage pipe and fittings.
  3. NPS 2 to NPS 12: PP/PVC double-containment drainage pipe and fittings.
  4. NPS 2 to NPS 12: PVDF double-containment drainage pipe and fittings.
  5. NPS 2 to NPS 12: PVDF/PVC double-containment drainage pipe and fittings.
- D. Aboveground Chemical-Waste Piping: Use [ any of] the following piping materials for each size range:
1. NPS 1-1/2 to NPS 6: PP drainage piping and [electrofusion] [mechanical] joints.
  2. NPS 1-1/2 to NPS 6: PVC drainage piping and solvent-cemented joints.
  3. NPS 1-1/2 to NPS 6: PVDF drainage piping and [electrofusion] [mechanical] joints.
  4. NPS 1-1/2 to NPS 6: NPS 2 to NPS 6 high-silicon-iron piping with hub-and-plain ends and calked joints.
  5. NPS 1-1/2 to NPS 4: High-silicon-iron piping with mechanical-joint ends, mechanical couplings, and coupled joints.
  6. NPS 1-1/2 to NPS 6: NPS 2 to NPS 4 stainless-steel drainage piping with socket-and-spigot ends and gasketed joints.
  7. NPS 1-1/2 to NPS 6: Borosilicate glass pipe and fittings, couplings, and coupled joints.
  8. NPS 8 to NPS 12: PVC drainage pipe and fittings and solvent-cemented joints.
  9. NPS 8 to NPS 12: High-silicon-iron piping with hub-and-plain ends and calked joints.
- E. Under Slab-on-Grade, Indoor, Chemical-Waste Piping: Use [ any of] the following piping materials for each size range:
1. NPS 1-1/2 to NPS 6: PP drainage piping and electrofusion joints.
  2. NPS 1-1/2 to NPS 6: PVC drainage piping and solvent-cemented joints.
  3. NPS 1-1/2 to NPS 6: PVDF drainage piping and electrofusion joints.
  4. NPS 1-1/2 to NPS 6: NPS 2 to NPS 4 high-silicon-iron piping with hub-and-plain ends and calked joints.
  5. NPS 1-1/2 to NPS 6: NPS 2 to NPS 4 stainless-steel drainage piping with socket-and-spigot ends and gasketed joints.
  6. NPS 1-1/2 to NPS 6: Borosilicate glass piping with covering, couplings, and coupled joints.

7. NPS 1-1/2 to NPS 6: [PE] [PP] [PP/PVC] [PVDF] [PVDF/PVC], double-containment drainage piping and manufacturer's standard joints.
8. NPS 8: PVC drainage piping and solvent-cemented joints.
9. NPS 8: High-silicon-iron piping with hub-and-plain ends and calked joints.
10. NPS 8: [PE] [PP] [PP/PVC] [PVDF] [PVDF/PVC], double-containment drainage piping and manufacturer's standard joints.
11. NPS 10 and NPS 12: PVC drainage piping and solvent-cemented joints.
12. NPS 10 to NPS 15: High-silicon-iron piping with hub-and-plain ends and calked joints.

**END OF SECTION**