

SECTION 22 66 00
CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

SPEC WRITER NOTE: Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for chemical-waste systems including piping, neutralization equipment, and all necessary accessories as designated in this section.
- B. A complete listing of common acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- E. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- F. Section 07 92 00, JOINT SEALANTS.
- G. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- I. Section 22 07 11, PLUMBING INSULATION.
- J. //Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all plumbing systems. Publications that apply to all plumbing systems may not be specifically referenced in the body of the specification but shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Where conflicts occur these specifications and the VHA standards will govern.

B. American Society of Mechanical Engineers (ASME):

- A13.1-2015.....Scheme for Identification of Piping Systems
- A112.3.1-2007.....Stainless Steel Drainage Systems for Sanitary
DWV, Storm, and Vacuum Applications, Above and
Below Ground
- B1.20.1-2013.....Pipe Threads, General Purpose, Inch
- B16.11-2016.....Forged Fittings, Socket-Welding and Threaded
- B16.12-2019.....Cast Iron Threaded Drainage Fittings
- B16.15-2018.....Cast Copper Alloy Threaded Fittings: Classes
125 and 250

C. American Society for Testing and Materials (ASTM):

- A74-2020.....Standard Specification for Cast Iron Soil Pipe
and Fittings
- A183-2014 (R2020).....Standard Specification for Carbon Steel Track
Bolts and Nuts
- A312/A312M-2019.....Standard Specification for Seamless, Welded,
and Heavily Cold Worked Austenitic Stainless
Steel Pipe
- A518/A518M-1999 (R2018) ..Standard Specification for Corrosion-Resistant
High-Silicon Iron Castings
- A666-2015.....Standard Specification for Annealed or
Cold-Worked Austenitic Stainless Steel Sheet,
Strip, Plate, and Flat Bar
- A733-2016.....Standard Specification for Welded and Seamless
Carbon Steel and Austenitic Stainless Steel
Pipe Nipples
- A861-2004 (R2017).....Standard Specification for High-Silicon Iron
Pipe and Fittings
- C564-2020a.....Standard Specification for Rubber Gaskets for
Cast Iron Soil Pipe and Fittings
- C1036-2016.....Standard Specification for Flat Glass
- D2321-2018.....Standard Practice for Underground Installation
of Thermoplastic Pipe for Sewers and Other
Gravity-Flow Applications
- D2654-2012 (R2018).....Standard Specification for Solvent Cements for
Poly(Vinyl Chloride) (PVC) Plastic Piping
Systems

- D2665-2014.....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- D2855-2015.....Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
- D3222-2018a.....Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials
- D4101-2017e1.....Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
- E84-2019b.....Standard Test Method for Surface Burning Characteristics of Building Materials
- F402-2018.....Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- F437-2015.....Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F493-2014.....Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
- F1412-2016.....Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems
- F1673-2010 (R2016).....Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems
- F2618-2019.....Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems
- D. Cast Iron Soil Pipe Institute (CISPI):
- 2006.....Cast Iron Soil Pipe and Fittings Handbook, 12th Printing

301-2018.....Standard Specification for Hubless Cast Iron
Soil Pipe and Fittings for Sanitary and Storm
Drain, Waste, and Vent Piping Applications

310-2018.....Specification for Coupling for Use in
Connection with Hubless Cast Iron Soil Pipe and
Fittings for Sanitary and Storm Drain, Waste,
and Vent Piping Applications

E. International Code Council (ICC):

IPC-2018.....International Plumbing Code

F. National Electrical Manufacturers Association (NEMA):

250-2018.....Enclosures for Electrical Equipment (1000 Volts
Maximum)

G. Underwriters' Laboratories, Inc. (UL):

723-2018.....Standard for Test for Surface Burning
Characteristics of Building Materials

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 66 00, CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES", with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

1. Chemical resistant waste and vent piping
2. Silver recovery piping
3. Ethylene oxide
4. Piping specialties
5. Neutralization tanks
6. Ceramic neutralization tanks
7. Continuous flow neutralization and monitoring system
8. Cleanouts
9. Floor drains
10. Waterproofing

D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

E. Shop Drawings: For neutralization system and leak-detection system. Include plans, elevations, sections, details, and in junction with //Electrical,// //Civil,// //Architectural// work.

1. Detail neutralization system assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Detail leak-detection system assemblies and indicate required clearances, method of field assembly, components, and location and size of each field connection.

3. Wiring Diagrams: For power, signal, and control wiring.

SPEC WRITER NOTE: Retain if work of this Section is required to withstand specific design loads and design responsibilities have been delegated to Contractor or if structural data are required as another way to verify compliance with performance requirements.

F. //Seismic-Design Submittal: For seismic restraints of aboveground piping, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.//

SPEC WRITER NOTE: Coordinate O&M Manual and commissioning requirements with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS. O&M Manuals shall be submitted for content review as part of closeout documents.

G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

H. //Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

- I. //Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <https://www.biopreferred.gov>.
- B. Refer to Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

- A. Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

SPEC WRITER NOTE: Retain if interruption of existing chemical-waste service is required.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:
 - 1. Provide written notice to COR no fewer than //two// // // days in advance of proposed interruption of chemical-waste service.
 - 2. Do not proceed with interruption of chemical-waste service without COR's written permission.

PART 2 - PRODUCTS

2.1 CHEMICAL RESISTANT WASTE AND VENT PIPING

- A. The material shall include connecting fittings in stacks or mains.

SPEC WRITER NOTES:

- 1. Designer to select the appropriate material piping materials from those listed below.
- 2. Coordinate all roof penetrations with architectural design details.
- 3. Borosilicate glass piping is no longer in common production. Manufacturing standards have been withdrawn. Coordinate with the facility for renovation work if glass piping is

still desired. Glass piping is not recommended for new construction.

- B. The chemical resistant waste and vent piping shall be high silicon iron pipe and drainage pattern fittings conforming to ASTM A518/A518M// or ASTM A861//. The high silicon cast-iron pipe shall be close grained, bell-and-spigot or beaded-end straight barrel, extra heavy, acid-resistant soil pipe conforming to ASTM A861 containing not less than 14.5 percent silicon content.
1. The joints shall be mechanical joint type constructed of AISI Type 304 corrosion-resistant steel with chloroprene resilient member supporting a TFE liner ensuring that the liner is the only material wetted by waste stream. Tighten all nuts to a minimum of 9 foot-pounds.
 2. The joints shall be bell and Spigot Joint type joint using acid resistant packing and lead calking materials.
- C. //The chemical resistant waste and vent pipe material shall be BSG pipe Class BSG-1 with drainage pattern fittings //tempered and annealed conforming to ASTM C1036, coupling per AISI Type 304 corrosion-resistant steel lined with Buna-N resilient member supporting a TFE liner, ensuring that the liner is the only material wetted by waste stream.//
- D. //The chemical resistant waste and vent pipe material shall be extruded polypropylene plastic pipe and drainage pattern fittings conforming to ASTM F1412 and tested in accordance with applicable provisions of ASTM D2665. The polypropylene pipe and fittings shall be Schedule 40 and made from a PP black olefin resin with a fire retardant additive complying with ASTM D4101 with mechanical joints for sizes under 75 mm or DN80 (NPS 3 inches) and fusion and mechanical joints for sizes 75 mm or DN80 (NPS 3 inches) and over.
1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation. Comply with applicable provisions of ASME B16.12 for material dimensions and configurations.//
- E. //The chemical resistant waste and vent pipe material shall be PVDF pipe and drainage pattern fittings conforming to ASTM F1673. The PVDF pipe and fittings shall be scheduled with mechanical joints for sizes under 75 mm or DN80 (NPS 3 inches) and fusion and mechanical joints for

sizes 75 mm or DN80 (NPS 3 inches) and over. Mechanical joints shall be used at all traps and trap arms.

1. Exception: Underground piping joints shall be fusion weld.//

F. //The chemical resistant waste and vent pipe material shall be Type 316L stainless-steel pipe and drainage pattern fittings conforming to ASME A112.3.1 and ASTM A666. The stainless-steel pipe shall have socket and spigot ends for gasket joints having piping manufacturer's FPM lip-seal rubber gaskets shaped to fit socket groove with plastic backup ring.//

G. //Chlorinated Poly (Vinyl Chloride) (CPVC) pipe shall be manufactured from CPVC Type IV, ASTM Cell Classification 23447 and in strict accordance to the requirements of ASTM F2618 for physical dimensions and tolerances and certified by NSF International for corrosive waste end use (NSF-cw). Joining method for pipe and fittings shall be solvent cement welding. Solvent cement shall be a solvent cement specially formulated for resistance to corrosive chemicals and manufactured in accordance with ASTM F493. This pipe shall have a flame spread rating of < 25 and a smoke development rating of < 50 when tested for surface burning characteristics in accordance with ASTM E84 and UL 723 or equivalent.//

2.2 SILVER RECOVERY PIPING

A. Silver recovery piping shall be Polyvinyl Chloride (PVC) pipe with drainage pattern fittings conforming to ASTM D2665.

2.3 ETHYLENE OXIDE (ETO) WASTE PIPING

A. ETO waste pipe material shall be Schedule 10, stainless-steel, conforming to ASTM A312/A312M with butt welded joints and fittings.

2.4 PIPING SPECIALTIES

A. Plastic dilution traps shall be corrosion resistant polypropylene with removable base and mechanical joint connections. The dilution tanks shall have a 3.8 liter (one gallon) capacity with a clear base unless color base is indicated. The dilution tank shall have two 38 mm or DN40 (NPS 1-1/2 inches) top inlets and one 38 mm or DN40 (NPS 1-1/2 inches) side outlet.

B. High silicon iron dilution traps shall have 38 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 to NPS 2 inches) as required for fixture and waste with mechanical joints and conforming to ASTM A861.

- C. Glass drain line interceptor drum traps shall have 38 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 or NPS 2 inches) as required for fixture and waste.
- D. Corrosion resistant P-trap or drum trap shall have 38 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 or NPS 2 inches) as required for fixture and waste and conform to ASTM A861 for high silicon iron pipe with hubless joints, ASTM D4101 for polypropylene pipe with mechanical joints, and ASTM D3222 for PVDF pipe with mechanical joints.

SPEC WRITER NOTE: Neutralization tanks with limestone chips or lumps may be used for low flow acidic (low pH) waste streams only in accordance with manufacturer's sizing criteria. Do not use for base (high pH) waste streams. For waste streams consisting of low and high pH effluent or high concentrated waste dump use a continuous flow neutralization and mixing system. Coordinate with VA user to determine waste characteristics. If sulfuric acid is used select dolomitic limestone. If sulfuric acid is not used, select 90% calcium carbonate limestone.

2.5 NEUTRALIZATION TANKS

- A. Plastic neutralization tanks shall have a capacity of // // liters (// // gallons) and be constructed from corrosion resistant plastic materials //HDPE// //HDPE or ASTM D4101, PP// //ASTM D4101, PP// with removable, gastight cover, inlet, vent, and discharge sidewall pipe connections. The tank shall be filled with limestone 25 to 75 mm (1 to 3 inch) chips or lumps with //a calcium carbonate content exceeding 90 percent// //dolomitic limestone 25 to 75 mm (1 to 3 inch) chips or lumps with more than 90 percent combined magnesium carbonate and calcium carbonate//.
- B. The traffic cover shall be //medium// //heavy// duty pedestrian traffic// //light duty vehicular with steel plate cover//.

2.6 CERAMIC NEUTRALIZATION TANKS

- A. Plastic ceramic shell neutralization tanks shall have a capacity of // // liters (// // gallons) and be constructed from corrosion-resistant, cast-ceramic shell. Include removable, reinforced-plastic, gastight cover, inlet, vent, and discharge sidewall pipe connections. Extension shall be //ceramic// //steel with protective coating//, 711 mm (28 inch) minimum diameter, and cast-iron manhole frame and cover. The tank shall be filled with limestone 25 to 75 mm (1 to 3 inch) chips

or lumps with //a calcium carbonate content exceeding 90 percent//
 //dolomitic limestone 25 to 75 mm (1 to 3 inch) chips or lumps with
 more than 90 percent combined magnesium carbonate and calcium
 carbonate//.

SPEC WRITER NOTES:

1. Coordinate and assure that the electrical characteristics specified below are clearly shown on appropriate drawings. Coordinate with Electrical Engineer.
2. Provide chemical resistant transfer pumps and associated piping if the project conditions do not allow gravity flow.

2.7 CONTINUOUS FLOW NEUTRALIZATION AND MONITORING SYSTEM

- A. The plastic tank acid neutralization monitoring system shall use a 120-volt factory wired and tested control system to continuously monitor the pH level of effluent with wiring and electrical power terminals. The monitoring system shall power the probes and the metering pumps.
- B. The panel shall be NEMA 250 Type 4X enclosure with the following features:
 1. Control devices.
 2. Indicators devices.
 3. Power light and on/off switch.
 4. pH Analyzer with meter and high and low pH indicators.
 5. //Low caustic and acid solution level indicators.//
 6. Alarm horn with silencer and reset switch.
 7. //Agitator running light with on/off switch.//
 8. //Running lights with on/off switches for caustic and acid solution pumps.//
- C. The recorder shall have a 30 day record capacity.
- D. The piping between the tanks shall be the same material as the chemical-waste and vent system.
- E. The interceptor tank shall function as a sediment trap and effluent equalization tank and shall be the same material as mixing and neutralization tank with removable, gastight cover, sidewall inlet and outlet connections and vent connection in the top. Internal piping shall be fitted with inlet elbows turned down to prevent settlement from flowing to mixing and neutralization tank.

- F. The mixing and neutralization tank shall be constructed from //HDPE// //polypropylene// //ceramic// in conformance with ASTM D4101. The pH probe type and length shall be suitable for the size of the mixing tank. The agitator shall be electric with stainless-steel shaft and propeller.
- G. The caustic solution storage tank shall be constructed from polypropylene in conformance with ASTM D4101. The caustic solution storage tank shall be filled with a sodium hydroxide solution.
- H. The acid solution storage tank shall be constructed from polypropylene in conformance with ASTM D4101. The acid solution storage tank shall be filled with a sulfuric acid solution.
- I. The metering pump shall be suitable for neutralizing solutions.
- J. The sampling tank shall be the same material as the mixing tank with removable, gastight cover, sidewall inlet and outlet connections and an opening in the top for a pH probe.

2.8 LEAK-DETECTION SYSTEMS

SPEC WRITER NOTE: Copy and revise this paragraph for each type of leak-detection system required.

- A. Cable leak-detection system capable of detecting and annunciating fluid leaks; with controls, panel, wiring, cable sensors, probes if required, and piping.
 - 1. Annunciator Panel: Enclosure with visual and audible alarms and leak location indicator.
 - 2. 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 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm or DN100 (NPS 4 inches); not less than 100 mm or DN100 (NPS 4 inches) for larger pipe. Cleanouts for chemical-waste drain pipe shall be of same material as the pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 610 mm (24 inches) shall be provided for clearing a clogged chemical-waste drain.
- B. Floor cleanouts shall have cast-iron body and frame with square adjustable scoriated secured nickel bronze top. The cleanout shall be vertically adjustable for a minimum of 50 mm or DN50 (NPS 2 inches). When a waterproof membrane is used in the floor system, a clamping

collar shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings.

- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. The vertical cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless-steel cover shall be furnished with a minimum opening of 152 by 152 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast-iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.10 FLOOR DRAINS

- A. Type L: Flushing Rim Drain. Heavy cast-iron body, double drainage pattern with flushing rim and clamping device. Solid bronze gasketed grate approximately 279 mm (11 inches) in diameter, with 50 mm (2 inch) length of 20 mm or DN20 (NPS 3/4 inch) brass pipe brazed or threaded into the center of the solid grate, pipe shall be threaded and provide brass cap with inter gasket (neoprene) to provide a gas tight installation. Attach deep seal P-trap to drain. Body and trap shall have pipe taps for water supply connections:

1. Drain Flange: Flange for synthetic flooring.

SPEC WRITER NOTE: See standard detail SD221300-01.DWG available at <https://www.cfm.va.gov/til/sDetail.asp>.

2. Cystoscopy Rooms:

- a. Flush Valve: The flush valve shall be large diaphragm type flushometer, solenoid operated with a single circuit timer. Mount in valve cabinet.
 - b. Operation: Valve solenoid shall be cycled by a single circuit timer set to operate flush valve at five minute intervals. Timer shall be electrically connected to an "on - off" toggle switch and be provided with pilot light. Timer and flush valve shall operate only when timer/valve switch is in the "on" position.
 - c. Valve Cabinets:
 - 1) General: Sheet metal not lighter than 1.6 mm thick (16 gauge), size as required, rigidly assembled with joints welded, and punched or drilled for passage of required pipes and services. Provide anchors for fastening cabinet in place. Front shall be flush with wall finish and shall have flush fitting, hinged doors, with latch. Door shall be arranged to not offer any obstruction when open.
 - 2) Doors and Trim: Flush with front of cabinet, constructed of not lighter than number 2.7 mm thick (12 gauge) steel. Doors shall open through 180 degrees and be provided with two butt hinges or continuous hinge. Latch shall be provided by manufacture of cabinet.
 - 3) Painting: Prime and finish painting is specified under Section 09 91 00, PAINTING.
- B. Type T: Funnel Type Chemical Resistant Floor Drain and "P" Trap: Double drainage pattern with integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. Provide outlet of floor drain suitable for properly jointing perforated or slotted floor level grate and funnel extension. Cut out grate below funnel. Minimum dimensions as follows:
1. Height of funnel - 95 mm (3-3/4 inches).
 2. Diameter of lower portion of funnel - 50 mm (2 inches).
 3. Diameter of top portion of funnel - 100 mm (4 inches).
- C. Type X: Chemical resistant floor drain and p-trap. Double drainage pattern with integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. Provide outlet of

floor drain suitable for properly joining with chemical resistant pipe material.

2.11 WATERPROOFING

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast-iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.

SPEC WRITER NOTE: Provide detail on drawings for waterproofing pipe penetration through wall. See standard detail SD220511-01.DWG available at <https://www.cfm.va.gov/til/sDetail.asp>.

- B. //Walls: See detail shown on drawings.//

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the International Plumbing Code and these specifications.
- B. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.
- C. Branch piping for chemical-waste piping system shall be installed and connected to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- D. Piping shall be installed for reagent racks. The piping shall be arranged neatly and located as required by the equipment.
- E. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
- F. All pipe runs shall be laid out to avoid interference with other work.
- G. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.
- H. The piping shall be installed to permit valve servicing or operation.

- I. The piping shall be installed at the indicated slopes or according to the International Plumbing Code.
- J. The piping shall be installed free of sags and bends.
- K. //Seismic restraint shall be installed where required by code.//
- L. Changes in direction for chemical-waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- M. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- N. Cast-iron piping shall be installed according to CISPI's "Cast-Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast-Iron Soil Pipe and Fittings".
- O. Aboveground CPVC piping shall be installed according to ASTM F2618. Underground CPVC piping shall be installed according to ASTM D2321.
- P. PVDF piping shall be installed according to ASTM F1673 and manufacturer's recommendations.
- Q. Silver recovery, aboveground PVC piping shall be installed according to ASTM D2665, and underground PVC piping shall be installed according to ASTM D2321.
- R. Chemical-resistant vent pipe shall be independently vented through the roof.

3.2 JOINT CONSTRUCTION

- A. Hub and spigot cast-iron piping with gasket joints shall be joined in accordance with CISPI's "Cast-Iron Soil Pipe and Fittings Handbook" for compression joints.

- B. Hub and spigot cast-iron piping with calked joints shall be joined in accordance with CISPI's "Cast-Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless, cast-iron piping shall be joined in accordance with CISPI's "Cast-Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
 - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855, ASTM D2654, and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.
- C. All chemical-waste piping shall be joined with specialty fittings in accordance with referenced standards and manufacturer's recommendations for the applications used.

3.4 NEUTRALIZATION TANK INSTALLATION

- A. Install exterior //collection// //collection and neutralization// //neutralization// tanks, complete with appurtenances indicated.
- B. Set tops of tank covers flush with finished surface where covers occur in pavements. Set covers 3 inches (75 mm) above finished surface elsewhere unless otherwise indicated. Include initial fill of limestone for neutralization tanks. Install interior neutralization tanks on smooth and level //concrete base// //floor surface//. Include full initial charge of limestone.

3.5 NEUTRALIZATION SYSTEM INSTALLATION

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

3.6 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.

3.7 PIPE HANGERS, SUPPORTS, AND ACCESSORIES

- A. All piping shall be supported and labeled according to the International Plumbing Code, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, ASME A13.1, and these specifications.
- B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint. Refer to Section 09 91 00, PAINTING.
- C. Horizontal piping and tubing shall be supported within 305 mm (12 inches) of each fitting or coupling.
- D. Vinyl coated hangers shall be installed for glass piping. The maximum horizontal spacing and minimum rod diameters shall be:
 - 1. For 25 mm or DN25 to 32 mm or DN32 (NPS 1 to NPS 1-1/4 inches), the maximum spacing shall be 1.22 meters (48 inches) with 10 mm (3/8 inch) rod.
 - 2. For 38 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 to NPS 2 inches), the maximum spacing shall be 1.83 meters (72 inches) with 10 mm (3/8 inch) rod.
 - 3. For 75 mm or DN80 (NPS 3 inches), the maximum spacing shall be 1.83 meters (72 inches) with 13 mm (1/2 inch) rod.
 - 4. For 100 mm or DN100 (NPS 4 inches), the maximum spacing shall be 1.83 meters (72 inches) with 16 mm (5/8 inch) rod.
- E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 meters (15 feet).
- F. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, and Hangers shall have the following characteristics:
 - 1. Solid or split unplated cast-iron.

2. All plates shall be provided with set screws.
 3. Height adjustable clevis type pipe hangers.
 4. Adjustable Floor Rests and Base Flanges shall be steel.
 5. Hanger Rods shall be carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 6. Riser Clamps shall be malleable iron or steel.
 7. Rollers shall be cast-iron.
 8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield centered on and welded to the hanger and support. The shield shall be 100 mm (4 inches) in length and be 16 gauge steel. The shield shall be sized for the insulation.
- G. Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories.
- H. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- I. Penetrations:
1. Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a firestop system that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the firestopping materials.
 2. At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- J. Chemical-waste and vent piping shall conform to the following:
1. Where waste lines from fixtures are shown on plans to be chemical resistant, vents from those fixtures shall also be chemical resistant.
 2. Storage and installation for PVDF or CPVC chemical resistant pipe shall comply with ASTM D2665.
 3. Glass Pipe installation shall be as recommended by the manufacturer. Glass pipe pitch shall be 1:50 (1/4 inch per foot), minimum.
 4. Silver recovery pipe pitch shall be 1:200 (0.5 percent), minimum.

5. Mechanically Joined Polypropylene Pipe requires a pre-grooved pipe or cutting of a groove in each pipe section using a rotation cutting tool. Polypropylene chemical resistant pipe pitch shall be 6 mm (1/4 inch per foot) minimum. Mechanically joined pipe shall not be installed below grade.
6. Plastic chemical-waste pipe shall not be installed within 23 m (75 feet) of hot water appliances (autoclaves, dishwashers, sterilizers) and similar equipment.
7. High silicon content cast-iron pipe with bell and spigot joints and heat fusion plastic pipe may be used below grade under building.
8. Stainless-steel, mechanical joints shall not be installed below grade.
9. Stainless-steel piping system shall be joined and supported per manufacturer's recommendations.

3.8 TESTS

- A. The chemical resistant pipe system shall be tested either in its entirety or in sections.
- B. Tests for Chemical Resistant Waste, vent, and Silver Recovery Systems shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted as directed.
 1. Entire system is tested using a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
 2. //Entire system is tested using an air pressure test of 34 kPa (5 psig). Pressure shall be maintained for at least 15 minutes without leakage. A force pump and column gauge shall be used for the test.//
 3. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with

smoke under pressure of 1.3 kPa (5 inch of water) with a smoke machine. Chemical smoke is prohibited.

- b. //Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.//

3.9 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. The tests shall include system capacity, control function, and alarm functions.
- C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- D. //The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.//

3.10 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.11 DEMONSTRATION AND TESTING

- A. Provide services of manufacturer's technical representative for //4//
// // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

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