A. GENERAL

1. All piping entering the Shipyard must be controlled per Shipyard Standard Procedure # 21.1-1.

2. All piping shall be in accordance with Facilities Department instruction # 508-006.

All piping (new, repairs, modification, etc.) shall be installed according to the following:

- Attachment # 1: Air – Low Pressure
- Attachment # 2: Air – High Pressure
- Attachment # 3: Argon
- Attachment # 4: Carbon Dioxide
- Attachment # 5: C-5
- Attachment # 6: Fresh (Potable) Water
- Attachment # 7: Fire (Water) Protection
- Attachment # 8: Fuel Oil
- Attachment # 9: Hydrogen Attachment
- Attachment #10: Propane and Natural Gas
- Attachment #11: Nitrogen
- Attachment #12: Oxygen – Low Pressure
- Attachment #13: Pure Water
- Attachment #14: Salt Water Cooling and TASW
- Attachment #15: Sewage
- Attachment #16: Steam Condensate
- Attachment #17: Steam
- Attachment #18: Storm Drain
16 May 2005

Department Instruction 508-006: Pipe Installation Specifications

Attachment #1: Air-Low Pressure

Scope: This specification is for the design, installation, test and repair of the shipyard air-low pressure system piping, including the compressor facility system and the air distribution system to the service connection on the piping system. In general, the air-low pressure system piping shall conform to the requirements of ASME B31.3 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Operating Pressure/Temperature: 100 psi. Temperature: Ambient
Design Pressure/Temperature: 100 psi. Temperature: Ambient

Materials:
Pipe and Fittings:
Above Ground
2” and smaller – Section 15061; Type S-1 (Sch 40, ASTM A53 Stl, 150#, Screwed or welded)
Type S-4 (Sch 40, ASTM A53 Stl, 125#, Flanged or welded)
2½” and larger – Section 15061; Type S-4 (Sch 40, ASTM A53 Stl, 125#, Flanged or welded)

Below Ground
All sizes – Section 15070; Special Underground Piping System, Type S-4

Valves:
2” and smaller – Section 15101; Type GT-1 (Gate, 125#, Screwed or welded) or Section 15103; Type B-2 (Ball, 600# 3-Piece, Full Port)
2½” and larger – Section 15101; Type GT-4 (Gate, 125#, Flanged or welded) or Section 15104; Type BF- 2 (Butterfly, 200#, Lugged)

Manufacturer: Bowes P/N 52026.

Testing:
Hydrostatic pressure test with water to 150 psi per ANSI B31.3. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Air – Low Pressure – 100 psi” and have yellow background with black lettering.
Attachment #2: Air – High Pressure

**Scope:** This specification is for the design, installation, test and repair of the shipyard high pressure air (HP Air) distribution system piping from the pressure reducing stations at the compressor station to the service connections on the piping system. The HP Air system piping shall conform to the requirements of ASME B31.3 for High Pressure Service except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

**Design:**
- Normal Operating Pressure/Temperature: 4,500 psi. Temperature: Ambient
- Design Pressure/Temperature: 5,000 psi. Temperature: 150°F

**Materials:**
- Note Pre-Cleaning Requirements of SSP 1.9
- **Pipe:** Section 15068; Type SS-4 (Sch. 160S, ASTM 312, Grade TP304, Stainless Steel)
- **Fittings:** Class 6000, socket weld, 304 Stainless Steel
- **Unions:** Class 6000, socket weld, 304 Stainless Steel, CPV O-Seal Model 51, Buna-N O-rings, Monel union nut.
- **Valves:** All valves shall be purchased commercially as Oxygen clean:
  - Class 6000, CPV O-Seal Shut-off Valve Model 380, 304 Stainless Steel, Buna-N O-rings, Polyurethane stem seal, and Teflon backup ring.
  - Class 6000, CPV Model 157 Relief Valve, Stainless Steel with Monel nuts.

**Testing:**
- Pneumatic pressure test to 7,500 psi with air per ANSI B31.3. (Note: Specific procedures and precautions for pneumatic testing found in ANSI B31.3 must be followed.) Minimum test duration shall be 10 minutes then reduce pressure to 5,000 psi and examine for leakage by soap bubble or equivalent method.
  - OR – Hydrostatic pressure test with Grade “B” water to 7,500 psi per ANSI B31.3. Minimum test duration shall be 10 minutes then reduce pressure to 5,000 psi and examine for leakage. Except for possible localized instances at pump or valve packing, there shall be no evidence of leakage. Drain and blow down lines following test.

System must be purged and dried to a -60°F dew point before being put into service.

**System Cleanliness:**
- Prior to fabrication, all piping, valves, assemblies, and components shall be cleaned per SSP 1.9 Attachment 1 (which meets the requirements of MIL-STD-1622).

The system cleanliness boundary for connection to the HPA system shall be established at the service connections by installation of the required filtration equipment. The system cleanliness boundary for connection to systems required to meet MIL-STD-1330 shall be established at the filtration equipment.

**Labeling:**
- Section 15190: Piping shall be labeled per the requirements of ASME B13.3. Labels shall read “Air – High Pressure – 4500 psi” and have yellow background with black lettering.
Department Instruction 508-006: Pipe Installation Specifications

Attachment #3: Argon

Scope: This specification is for the design, installation, test and repair of the shipyard argon system piping from the pressure/temperature control module at the argon storage tank to the service connection on the piping system. The argon system piping shall conform to the requirements of ASME B31.3 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Normal Operating Pressure/Temperature: 135 psi.  Temperature: Ambient
Design Pressure/Temperature: 150 psi.  Temperature: Ambient

Materials:
Pipe and Fittings:
Above Ground
Section 15062, Type C-3 (K – Copper, ASTM B88, Brazed), Type B-1 (Red Brass, ASTM B43, Sch 40, Brazed) or Type C-5 (Copper, ASTM B42, Sch 40, Brazed)
Below Ground
Section 15062, Type B-1 (Sch 40 Red Brass, ASTM B43, Brazed) or Type C-5 (Sch 40 Copper, ASTM B42, Brazed)

Valves: All valves shall be purchased commercially Oxygen clean:
Line Valves –
Manufacturer: Rego 2500 series diaphragm, bronze body.
Service Manifold Valves –
Manufacturer: Rego 7160 series.

Testing:

Pneumatic pressure test with nitrogen to 225 psi per ANSI B31.3. (Note: Specific procedures and precautions for pneumatic testing found in ANSI B31.3 must be followed.) All joints are to be tested using a soap bubble method. Once all leaks are repaired and the bubble test indicates no leaks, a 24-hour drop test at 225 psi shall be preformed on the system.

System Cleanliness:

Prior to fabrication, all piping, valves, assemblies, and components shall be cleaned SSP 1.9 Attachment 1 (which meets the requirements of MIL-STD-1622). Note that these cleanliness requirements are similar for HPA. During fabrication, piping shall be maintained under nitrogen pressure or purge at all times.

Following the final test the system shall be evacuated to 25 inches mercury vacuum then break the vacuum with argon. Lab Services, Dept. 341, shall test argon purity from system. Repeat this process until Dept 341 validates argon purity.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Argon” and have blue background with white lettering.
Attachment #4: Carbon Dioxide

Scope: This specification is for the design, installation, test and repair of the shipyard Carbon Dioxide system. In general, the Carbon Dioxide system piping shall conform to the requirements of ASME B31.3 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Operating Pressure/Temperature: 135 psi. Temperature: Ambient
Design Pressure/Temperature: 150 psi. Temperature: Ambient

Materials:
Pipe and Fittings:
Above Ground
   Section 15062, Type C-3 (K – Copper, ASTM B88, Brazed), Type B-1 (Red Brass, ASTM B43, Sch 40, Brazed) or Type C-5 (Copper, ASTM B42, Sch 40, Brazed)
Below Ground
   Section 15062, Type B-1 (Sch 40 Red Brass, ASTM B43, Brazed) or Type C-5 (Sch 40 Copper, ASTM B42, Brazed)

Valves: Line Valves –
   Manufacturer: Rego 2500 series.
   Service Manifold Valves –
   Manufacturer: Rego 7160 series.

Testing:
Hydrostatic pressure test with water to 225 psi per ANSI B31.3. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:
Prior to fabrication, all piping, valves, assemblies, and components shall be cleaned SSP 1.9 Attachment 1 (which meets the requirements of MIL-STD-1622). Note that these cleanliness requirements are similar for HPA. During fabrication, piping shall be maintained under nitrogen pressure or purge at all times.
Following the final test the system shall be evacuated to 25 inches mercury vacuum then break the vacuum with CO2 gas. Lab Services, Dept. 341, shall test CO2 gas purity from system. Repeat this process until Dept 341 validates CO2 gas purity.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels should read “Carbon Dioxide – CO2” and shall have yellow background with black lettering.
Department Instruction 508-006: Pipe Installation Specifications

Attachment #5: C-5 Mixed Gas (95% Argon with 5% Carbon Dioxide)

Scope: This specification is for the design, installation, test and repair of the shipyard C-5 system piping from the gas mixing stations to the service connection on the piping system. The C-5 system piping shall conform to the requirements of ASME B31.3 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
- Normal Operating Pressure/Temperature: 65 psi, Temperature: Ambient
- Design Pressure/Temperature: 100 psi, Temperature: Ambient

Materials:
- Pipe and Fittings:
  - Above Ground: Section 15062, Type C-3 (K – Copper, ASTM B88, Brazed), Type B-1 (Red Brass, ASTM B43, Sch 40, Brazed) or Type C-5 (Copper, ASTM B42, Sch 40, Brazed)
  - Below Ground: Section 15062, Type B-1 (Sch 40 Red Brass, ASTM B43, Brazed) or Type C-5 (Sch 40 Copper, ASTM B42, Brazed)
- Valves:
  - Line Valves – Manufacturer: Rego 2500 series.
  - Service Manifold Valves – Manufacturer: Rego 7160 series.

Testing:
- Pneumatic pressure test with nitrogen to 150 psi per ANSI B31.3. (Note: Specific procedures and precautions for pneumatic testing found in ANSI B31.1 must be followed.) All joints are to be tested using a soap bubble method. Once all leaks are repaired and the bubble test indicates no leaks, a 24-hour drop test at 225 psi shall be preformed on the system.

System Cleanliness:
Prior to fabrication, all piping, valves, assemblies, and components shall be cleaned SSP 1.9 Attachment 1 (which meets the requirements of MIL-STD-1622). Note that these cleanliness requirements are similar for HPA. During fabrication, piping shall be maintained under nitrogen pressure or purge at all times.

Following the final test the system shall be evacuated to 25 inches mercury vacuum then break the vacuum with C-5 gas. Lab Services, Dept. 341, shall test C-5 gas purity from system. Repeat this process until Dept 341 validates C-5 gas purity.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “C-5 Gas” and have blue background with white lettering.
Attachment #6: Fresh (Potable) Water

Scope: This specification is for the design, installation, test and repair of the shipyard fresh (potable) water. In general, the fresh (potable) water system piping shall conform to the requirements of American Water Works Association (AWWA) and appropriate Building Codes except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Operating Pressure/Temperature: 100 psi. Temperature: Ambient
Design Pressure/Temperature: 125 psi. Temperature: Ambient

Materials:
Pipe and Fittings:
Pipe and fittings (2 inches and smaller) above grade shall be copper, Specification Section 15062, System Type C-1.
Pipe and fittings (2-1/2 inches and larger) above grade shall be copper, Specification Section 15062, System Type C-2.

**OR**
Pipe and fittings (2-1/2 inches and larger) above grade shall be steel, Specification Section 15061, System Type S-9.
Pipe and fittings (2 inches and smaller) below grade shall be copper, Specification Section 15062, System Type C-3.
Pipe and fittings (2-1/2 inches and larger) below grade shall be ductile iron, Specification Section 15064, System Type DI-1 or DI-2, at the Contractor's option.

Valves:
Isolation valves at equipment (2 inches and smaller) shall be ball valves, Specification Section 15103, Valve Type B-1.
Isolation valves at equipment (2-1/2 inches and larger) shall be gate valves, Specification Section 15101, Valve Type GT-4.
Isolation valves in piping runs (2 inches and smaller) except at building entrance shall be ball valves, Specification Section 15103, Valve Type B-2.
Isolation valves in piping runs (2-1/2 inches and larger), except at building entrance, shall be gate valves, Specification Section 15101, Valve Type GT-4.
Check valves at pump discharges (2 inches and smaller) shall be per Specification Section 15106, Valve Type C-3.
Check valves at pump discharges (2-1/2 inches and larger) shall be per Specification Section 15106, Valve Type C-6.
Check valves for general use (2 inches and smaller) shall be per Specification Section 15106, Valve Type C-1.
Check valves for general use (2-1/2 inches and larger) shall be per Specification Section 15106, Valve Type C-3.
Drain valves shall be boiler drains per Specification Section 15110, Valve Type SD-1.
Strainer blow-down valves shall be ball valves, Specification Section 15103, Valve Type B-1.

Attachment #6: Fresh (Potable) Water, cont.
Testing:
Hydrostatic pressure test with water to 188 psi. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication.

All water lines shall be disinfected using the following procedure. Preliminary flushing shall be done prior to chlorination as thoroughly as possible with water pressure and outlets available.

Sterilization
a) Before being placed in service, all new mains, branches, and lines shall be chlorinated by introducing a solution containing not less than 50 parts per million of chlorine.

b) The chlorine-bearing compounds to be used shall be calcium hypochlorite, chlorinated lime or sodium hypochlorite.

c) In the process of chlorinating the system, all valves or appurtenances shall be operated while the lines are being filled with the chlorinating agent.

d) With the required chlorine solution present, the system shall be secured for a period of not less than 24 hours. After retention period, tests shall be made to determine a chlorine residual of not less than 10 ppm.

Final Flushing and Test

Following chlorination, all treated water shall be flushed from the system at its extremities until the replacement water throughout the system shall be proved comparable in quality to the water from the water supply system and approved by the Owner.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Potable Water” have green background with white lettering.
**Description**: This specification is for the installation, test, repair and flushing of buried fire protection mains including piping, isolation valves, thrust blocks, and hydrants.

**Design**:
- Nominal Operating Pressure/Temperature: 125psi  Temperature: Ambient
- Design Pressure/Temperature: 125psi  Temperature: Ambient

**Materials**:

  **WET-PIPE SPRINKLER SYSTEM PIPE AND FITTINGS**
  - Pipe and fittings (2 inches and smaller) above grade, shall be steel, System Type S-8.
  - Pipe and fittings (2-1/2 inches and larger) above grade, shall be steel, System Type S-10.
  - Pipe and fittings, below grade, shall be ductile iron, System Type DI-2.

  **DRY-PIPE SYSTEM PIPE AND FITTINGS**
  - Pipe and fittings (2 inches and smaller) shall be steel, System Type S-8.
  - Pipe and fittings (2-1/2 inches and larger) shall be steel, System Type S-10.

  **SPRINKLER SYSTEM VALVES**
  - Isolation valves (2 inches and smaller) shall be gate valves, Valve Type GT-3.
  - Isolation valves (2-1/2 inches and larger) shall be gate valves, Valve Type GT-6.
  - Trim valves at alarm valves shall be ball valves, Valve Type B-1.
  - Check valves (2-1/2 inches and larger) shall be Valve Type C-7.
  - Wet pipe and dry pipe alarm valves shall be as specified in Section 15322, SPRINKLER SYSTEM ALARM VALVES.

**Installation**:

**Testing**:
- Testing for both buried and exposed fire mains shall be the same: Hydrostatic pressure test with water to 200 psi for two (2) hours. There shall be no pressure drop or evidence of leakage. Testing shall be witnessed by the Authority Having Jurisdiction and EB Facilities.

**System Cleanliness**:
- All new or modified existing piping systems shall be flushed at a required flow to produce a minimum velocity of 10 feet per second (3 m/s) in the pipes, until all potential debris has been removed. Wet systems shall be left in the wet condition: dry systems shall be completely drained and air blown dry.

**Labeling**:
- **Section 15190**: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Fire Protection” and have red background with white lettering.
Department Instruction 508-006: Pipe Installation Specifications

Attachment #8: Fuel Oil

Scope: This specification is for the design, installation, test and repair of the shipyard Fuel Oil system piping including #4 Fuel Oil and Diesel Fuel Oil. In general, the Fuel Oil system piping shall conform to the requirements of ASME B31.2 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
- Nominal Operating Pressure/Temperature: 100 psi, Temperature: 80°F
- Design Pressure/Temperature: 150 psi, Temperature: 100°F

Materials:
- Pipe:
  - 2” and smaller – Section 15061; Type S-1 (Sch 40, ASTM A53, Grade B Stl, 150#, plain ends)
  - 2½” and larger – Section 15061; Type S-4 (Sch 40, ASTM A53, Grade B Stl, 125#, beveled ends)
- Fittings:
  - 2” and smaller – 3000# forged steel socket weld to ASTM A105 (non-heat treated)
  - 2½” and larger – Standard weight seamless steel butt weld end to A234, Grade WPB
- Unions:
  - 3000# forged steel socket weld to A105 (non-heat treated) integral seats
- Flanges:
  - 2½” and larger – 150# forged steel weld neck with standard bore or slip-on to A181, Grade I, ANSI B16.5 raised face.
- Valves:
  - 2” and smaller – Ball: Steel socket weld, 800# 3 piece steel body, 11-13% chrome ball and stem, bolted body, Teflon seats, with lever, Pacific Model 326-CS-P5FS or approved equal.
  - Gate: Steel socket-weld, 800# steel body, 11-13% chrome trim with stellite seat rings, OS&Y, bolted bonnet, solid disc, standard packing, Pacific Model 596-2 or approved equal.
  - Globe: Steel socket-weld, 800# steel body, 11-13% chrome trim with stellite integral seats, OS&Y, bolted bonnet, manufacturer’s standard packing, Pacific Model 7662-2 or approved equal.
  - Check: Steel socket-weld, 800# steel body, 11-13% chrome trim with stellite integral seats, piston type, bolted cap, Pacific Model 3682-2 or approved equal.
  - 2½” and larger - Gate: Cast Steel flanged, 150# steel body, 11-13% chrome trim, OS&Y, bolted bonnet, solid or flexible disc, manufacturer’s standard packing, Crane Model 47X or approved equal.
  - Globe: Cast Steel flanged, 150# steel body, 11-13% chrome trim, OS&Y, bolted bonnet, plug type disc, manufacturer’s standard packing, Pacific Model 160-1 or approved equal.
  - Check: Cast Steel flanged, 150# steel body, 11-13% chrome trim, swing type bolted bonnet, Pacific Model 180-1 or approved equal.

Testing:

Hydrostatic pressure test with water to 225 psi per ANSI B31.2. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.
System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Fuel Oil” and have yellow background with black lettering.
Attachment #9: Hydrogen

Scope: This specification is for the design, installation, test and repair of the shipyard Hydrogen Gas system piping from the hydrogen storage tanks to the service connection on the piping system. The Hydrogen Gas Distribution system piping shall conform to the requirements of ASME B31.3, *Process Piping*, and NFPA 50A, *Standard for Gaseous Hydrogen Systems at Consumer Sites*. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:

Normal Operating Pressure/Temperature: 15 psi. Temperature: Ambient
Design Pressure/Temperature: 50 psi. Temperature: Ambient

Materials:

Pipe: Section 15061; Type S-12 (Sch 40, ASTM A53 Stl, Socket Welded)
Valves:
   Line Valves – Section 15102, Type GL-2 (300 PSIG, Screwed)
   Service Manifold Valves – Manufacturer: ½” AIRCO #801-0468 (left hand threads) w/cap and chain, or approved equal.

Testing:

Hydrostatic pressure test with water to 75 psi per ANSI B31.3. Minimum test duration shall be 60 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines with nitrogen following test.

System Cleanliness:

Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication.
Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:

Section 15190: Piping shall be labeled per the requirements of ASME B13.1. Labels shall read “Hydrogen Gas” and have yellow background with black lettering.
Department Instruction 508-006: Pipe Installation Specifications

Attachment #10: Propane & Natural Gas

Scope: This specification is for the design, installation, test and repair of the shipyard Propane and Natural Gas system piping from the propane storage tanks or natural gas meter stations to the service connection on the piping system. The Propane and Natural Gas Distribution system piping shall conform to the requirements of the National Fuel Gas Code, ANSI Z223.1 (NFPA 54). Piping systems for liquid propane shall conform to the requirements of the LP Gas Code, NFPA 58. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Distribution Pressure/Temperature:
Propane: 12 psi, Temperature: Ambient
Natural Gas: 20 psi, Temperature: Ambient
Design Pressure/Temperature:
Propane and Natural Gas: 50 psi, Temperature: Ambient

Materials:
Pipe:
Above Ground: Section 15061; Type S-12 (Sch 40, ASTM A53 Stl, Socket Welded)
Below Ground: Section 15061; Type S-13 (Sch 80, ASTM A53 Stl, Socket or Butt Welded)
Valves:
Line Valves – Section 15102, Type GL-2 (300 PSIG, Screwed)
Service Manifold Valves – Manufacturer: ½” AIRCO #801-0468 (left hand threads) w/cap and chain, or approved equal.

Testing:
Pneumatic pressure test with nitrogen to 75 psi per NFPA 54. Minimum test duration shall be 30 minutes for each 500 cu ft of pipe volume or fraction thereof until all joints are inspected there shall be no pressure drop or evidence of leakage.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME B13.1. Labels shall read “Propane” or “Natural Gas” and have yellow background with black lettering.
Department Instruction 508-006: Pipe Installation Specifications

Attachment #11: Nitrogen

Scope: This specification is for the design, installation, test and repair of the shipyard nitrogen distribution system piping from the pressure reducing stations at the nitrogen storage tank and pump station to the service connection on the piping system. The nitrogen system piping shall conform to the requirements of ASME B31.3 for High Pressure Service except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Normal Operating Pressure/Temperature: 3,000 psi. Temperature: Ambient
Design Pressure/Temperature: 3,500 psi. Temperature: 100°F

Materials:
Note Pre-Cleaning Requirements of SSP 1.9
Pipe: Section 15068; Type SS-3 (Sch. 80S, ASTM 312, Grade TP304, Stainless Steel) or Type SS-4 (Sch. 160S, ASTM 312, Grade TP304, Stainless Steel)
Fittings: Class 6000, socket weld, 304 Stainless Steel
Unions: Class 6000, socket weld, 304 Stainless Steel, CPV O-Seal Model 51, Buna-N O-rings, Monel union nut.
Valves: All valves shall be purchased commercially Oxygen clean:
Class 6000, CPV O-Seal Shut-off Valve Model 380, 304 Stainless Steel, Buna-N O-rings, Polyurethane stem seal, and Teflon backup ring.

Testing:
Pneumatic pressure test to 5,250 psi. with nitrogen per ANSI B31.3. (Note: Specific procedures and precautions for pneumatic testing found in ANSI B31.3 must be followed.) Minimum test duration shall be 10 minutes then reduce pressure to 3,500 psi and examine for leakage by soap bubble or equivalent method. – OR – Hydrostatic pressure test with Grade “A” water to 5,250 psi. per ANSI B31.3. Minimum test duration shall be 10 minutes then reduce pressure to 3,500 psi and examine for leakage. Except for possible localized instances at pump or valve packing, there shall be no evidence of leakage. Drain and blow down lines following test.
Lines must be purged and dried to a -60°F dew point before being put into service.

System Cleanliness:
Prior to fabrication, all piping, valves, assemblies, and components shall be cleaned SSP 1.9. During fabrication, piping shall be maintained under nitrogen pressure or purge at all times.

Following the final test the system shall be evacuated to 25 inches mercury vacuum then break the vacuum with Nitrogen gas. Lab Services, Dept. 341, shall test Nitrogen gas purity from system. Repeat this process until Dept 341 validates Nitrogen gas purity.

The system cleanliness boundary for connection to the Nitrogen system shall be established at the service connection by installation of the required filtration equipment. The system cleanliness boundary for connection to systems required to meet MIL-STD-1330 shall be established at the point of filtration.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME B13.1. Labels shall read “NITROGEN – 3000 psi” and have yellow background with black lettering.
June 16, 2005

Department Instruction 508-006: Pipe Installation Specifications

Attachment #12: Oxygen – Low Pressure

Scope: This specification is for the design, installation, test and repair of the shipyard oxygen system piping from the pressure/temperature control module at the oxygen storage tank to the service connection on the piping system. The oxygen system piping shall conform to the requirements of ASME B31.3 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
- Normal Operating Pressure/Temperature: 125 psi. Temperature: Ambient
- Design Pressure/Temperature: 150 psi. Temperature: Ambient

Materials: Note Pre-Cleaning Requirements of SSP 1.9
- Pipe and Fittings:
  - Above Ground: Schedule 40, ASTM A53 Steel, 3000# forged steel socket weld fittings per ANSI B16.11
  - Below Ground: Schedule 80, ASTM A53 Steel, 3000# forged steel socket weld fittings per ANSI B16.11
- Valves: All valves shall be purchased commercially Oxygen clean:
  - Line Valves – Manufacturer: Lunkenheimer 400# WOG Bronze Figure 405 w/ non-metallic disc No.60 (Teflon) cleaned for oxygen service, or approved equal
  - Service Manifold Valves – Manufacturer: ½” AIRCO #801-0469 w/cap and chain #801-7547, cleaned for oxygen service, or approved equal

Testing:
- Pressure testing shall be performed before the final system flush. Pneumatic pressure test to 180 psi. with nitrogen per ANSI B31.3. (Note: Specific procedures and precautions for pneumatic testing found in ANSI B31.3 must be followed.) Minimum test duration shall be 10 minutes then reduce pressure to 150 psi and examine for leakage by soap bubble or equivalent method.
  - OR –
  - Hydrostatic pressure test with Grade “A” water to 225 psi. per ANSI B31.3. Minimum test duration shall be 10 minutes then reduce pressure to 150 psi and examine for leakage. Except for possible localized instances at pump or valve packing, there shall be no evidence of leakage. Drain and blow down lines with nitrogen following test.

System Cleanliness:

Prior to and following fabrication, all piping, valves, assemblies, and components shall be cleaned to the requirements of MIL-STD-1330 (EB SSP 1.9). Prior to assembly and after initial cleaning, openings in all piping, valves assemblies, and components shall be sealed and labeled as Oxygen Clean until assembly. During fabrication, piping shall be maintained under nitrogen pressure or purge at all times.

Labeling:
- Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Oxygen – 125 psi” and have a yellow background with black lettering.
Attachment #13:  Pure Water

**Scope:** This specification is for the design, installation, test and repair of the shipyard Pure Water system piping, including the Pure Water Facility. In general, the Pure Water system piping shall conform to the requirements of ASME B31.3 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

**Design:**

Nominal Operating Pressure/Temperature: 100 psi. Temperature: Ambient

Design Pressure/Temperature: 150 psi. Temperature: Ambient

**Materials:**

*Note Pre-Cleaning Requirements of NSI 3002*

**Pipe:**

- 2” and smaller – Schedule 40S seamless stainless steel, A312, Grade TP-304L, plain ends
- 2½” and larger – Schedule 10S seamless stainless steel, A312, Grade TP-304L, beveled ends

**Fittings:**

- 2” and smaller – 3000# forged stainless steel, socket weld, A182, Grade F304L
- 2½” and larger – Schedule 10S seamless stainless steel butt weld fittings, A312, Grade WP-304L

**Unions:**

- 3000# forged stainless steel, socket weld, A182, Grade F304L, integral seat

**Valves – All valves shall be purchased commercially Oxygen clean:**

- **2” & smaller – Ball:** Stainless Steel socket weld, 800# 3 piece steel 304L body, stainless trim, bolted body, Teflon seats, with lever, Pacific Model 326-S-P5FS or app’d equal.
- **Gate:** Stainless Steel socket-weld, 150# stainless Type 304L body and trim, OS&Y, bolted bonnet, double disc, Teflon packing, Aloyco Model 114 or approved equal.
- **Globe:** Stainless Steel socket-weld, 300# stainless Type 304L body and trim, OS&Y, bolted bonnet, modified plug type disc, Teflon packing, Aloyco 2314A or approved equal.
- **Check:** Stainless Steel socket-weld, 150# stainless Type 304L body and trim, bolted cap, swing type, Aloyco Model 374 or approved equal.
- **2½” & larger - Gate:** Stainless Steel flanged, 150# stainless Type 304 body and trim, MSS Flat Face, OS&Y, bolted bonnet, double disc, Teflon packing, Aloyco Model 111 or approved equal.
- **Check:** Stainless Steel flanged, 150# stainless steel Type 304 body and trim, MSS Flat Face, swing type, bolted bonnet, Aloyco Pacific Model 371 or app’d equal.

**Testing:**

Hydrostatic pressure test with water to 225 psi per ANSI B31.3. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

**System Cleanliness:**

The Pure Water system is to be established, verified and maintained Grade ‘A’ Clean per NSI 3002 and 3024.

**Labeling:**

Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Pure Water” and have green background with white lettering.
Scope: This specification is for the design, installation, test and repair of the shipyard Temporary Auxiliary Saltwater (TASW) System. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Operating Pressure/Temperature: 50 psi. Temperature: Ambient
Design Pressure/Temperature: 125 psi. Temperature: 100°F

Materials:
Pipe and Fittings:
- Above Ground:
  All Sizes – Section 15061; Type S-1 (Sch 40, ASTM A53 Stl, 150#, Screwed or welded)
  Type S-4 (Sch 40, ASTM A53 Stl, 125#, Flanged or welded)
  Type S-7 (Sch 40, ASTM A53 Stl, 125#, Grooved)
  Type S-8 (Sch 40, ASTM A53 Stl, 125#, Galv, Screwed)
  Type S-9 (Sch 40, ASTM A53 Stl, 125#, Galv, Flanged)
  Type S-10 (Sch 40, ASTM A53 Stl, 125#, Galv, Grooved)
- Section 15066; Type P-4 (Sch 80, CPVC)
- Below Ground:
  All sizes – Section 15061; Type S-5 (Sch 80, ASTM A53 Stl, 250#, Flanged or welded)

Valves:
- 2” and smaller – Section 15101; Type GT-1 (Gate, 125#, Screwed or welded) or Section 15103; Type B-2 (Ball, 600# 3-Piece, Full Port); Type B-3 (Ball, 150#, 3-piece, plastic); Section 15106 (Check, 125#, Screwed)
- 2½” and larger – Section 15101; Type GT-4 (Gate, 125#, Flanged or welded) or Section 15104; Type BF-2 (Butterfly, 200#, Lugged); Section 15106 (Check, 125#, Flanged)

Testing:
Hydrostatic pressure test with water to 138 psi. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Temp Aux Sea Water - TASW” and have green background with white lettering.
Department Instruction 508-006: Pipe Installation Specifications

Attachment #15: Sewage

Scope: This specification is for the design, installation, test and repair of the shipyard Sewage system. In general, the Sewage system piping shall conform to the requirements of “State of Connecticut Department of Transportation, Standard specifications for Roads, Bridges and Incidental Construction, Form 814A” except as specifically identified by contract or work order.

Design:

Nominal Operating Pressure/Temperature: Gravity or Pressurized; Temperature: Ambient
Design Pressure/Temperature: Temperature: Ambient

Materials:

Pipe and Fittings:

Below Ground

All sizes – Shall be as determined by and specified by the design engineer within Best Management Practices.

Valves: Pressurized systems only

2½” and larger – Section 15101; As specified by the Design Engineer; Type GT-4 (Gate, 125#, Flanged or welded) or Section 15104; Type BF-2 (Butterfly, 200#, Lugged)

Testing:

Hydrostatic pressure test with water for pressurized systems: 100 psi. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

Hydrostatic pressure test with water for gravity feed systems: 10 psi. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:

Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:

Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Sewage” and have Green background with white lettering.
Scope: This specification is for the design, installation, test and repair of the shipyard Steam Condensate system piping. In general, the condensate system piping shall conform to the requirements of ASME B31.1 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Operating Pressure/Temperature: 70 psi. Temperature: 315°F  
Design Pressure/Temperature: 125 psi. Temperature: 350°F

Materials – See Specification Section 15520
Pipe and fittings:
2 inches and smaller shall be steel, Specification Section 15061, System Type S-2.  
2-1/2 inches and larger shall be steel, Specification Section 15061, System Type S-5.  
All sizes below grade Specification Section 15070; Special Underground Piping System, Type S-5

Valves:
Isolation valves (2 inches and smaller) shall be gate valves, Specification Section 15101, Valve Type GT-1.  
Isolation valves (2-1/2 inches and larger) shall be gate valves, Specification Section 15101, Valve Type GT-4.  
Blowdown and Bypass valves (2 inches and smaller) shall be globe valves, Specification Section 15102, Valve Type GL-1.  
Blowdown and Bypass valves (2-1/2 inches and larger) shall be globe valves, Specification Section 15102, Valve Type GL-3.  
Drain valves shall be service drains per Specification Section 15110, Valve Type SD-1.

Testing:
Hydrostatic pressure test with water to 188 psi per ANSI B31.1. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication.  
Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Steam Condensate” and have yellow background with black lettering.
Attachment #17: Steam

Scope: This specification is for the design, installation, test and repair of the shipyard steam-low pressure system piping. In general, the steam-low pressure system piping shall conform to the requirements of ASME B31.1 except as specifically identified by contract or work order. Specification sections refer to the latest version of the Facilities Material Specifications.

Design:
Nominal Operating Pressure/Temperature: 70 psi. Temperature: 315°F
Design Pressure/Temperature: 125 psi. Temperature: 350°F

Materials – See Specification Section 15520
Pipe:
2” and smaller – Section 15061; Type S-1 (Sch 40, ASTM A53, Grade B Stl, 150#, plain ends)
2½” and larger – Section 15061; Type S-4 (Sch 40, ASTM A53, Grade B Stl, 125#, beveled ends)
All sizes below grade Section 15070; Special Underground Piping System, Type S-5

Fittings:
2” and smaller – 3000# forged steel socket weld to ASTM A105 (non-heat treated)
2½” and larger – Standard weight seamless steel butt weld end to A234, Grade WPB

Unions:
3000# forged steel socket weld to A105 (non-heat treated) integral seats

Flanges:
2½” and larger – 150# forged steel weld neck with standard bore or slip-on to A181, Grade I, ANSI B16.5 raised face.

Valves:
Isolation valves (2 inches and smaller) shall be gate valves, Specification Section 15101, Valve Type GT-1.
Isolation valves (2-1/2 inches and larger) shall be gate valves, Specification Section 15101, Valve Type GT-4.
Valves (2 inches and smaller) shall be globe valves, Specification Section 15102, Valve Type GL-1.
Valves (2-1/2 inches and larger) shall be globe valves, Specification Section 15102, Valve Type GL-3.
Drain valves shall be service drains per Specification Section 15110, Valve Type SD-1.

Testing:
Hydrostatic pressure test with water to 188 psi per ANSI B31.1. Minimum test duration shall be 10 minutes or until all joints are inspected there shall be no pressure drop or evidence of leakage. Drain and blow down lines following test.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Steam” and have yellow background with black lettering.
Attachment #18: Storm Drain

Scope: This specification is for the design, installation, test and repair of the shipyard Storm Drain system. In general, the Storm Drain system piping shall conform to the requirements of “State of Connecticut Department of Transportation, Standard specifications for Roads, Bridges and Incidental Construction, Form 814A” except as specifically identified by contract or work order.

Design:
- Nominal Operating Pressure/Temperature: Gravity or Pressurized; As determined by design Temperature: Ambient
- Design Pressure/Temperature: As determined by design Temperature: Ambient

Materials:
- Pipe and Fittings:
  - Below Ground
    - All sizes – Shall be as determined by and specified by the design engineer within Best Management Practices.

Testing:
- Visual inspection for leakage under static pressure conditions.

System Cleanliness:
Piping shall be wiped free, inside and outside of all oil, grease, metal cuttings, and debris during fabrication. Following test, all equipment, piping, valves, and strainers shall be cleaned inside and outside of oil, grease, metal cuttings, and sludge that may have accumulated during tests and dried. All surplus materials and debris shall be removed as directed.

Labeling:
Section 15190: Piping shall be labeled per the requirements of ASME A13.1. Labels shall read “Storm Drain” and have yellow background with black lettering.
SECTION 15015

DIVISION 15 SPECIFICATIONS

B. ARRANGEMENT OF DIVISION 15 SPECIFICATION SECTIONS

1. The following paragraphs are offered as a guide only and are not intended to scope the work of any Contractor, subcontractor, or supplier.

   a. The 15000, 15100, and 15200 series section numbers (Sections 15000 through 15299, inclusive) are reserved for the specification of basic mechanical requirements, materials, methods, and equipment. Sections in this group will generally pertain to the work of more than one mechanical trade (such as both Heating, Ventilating and Air Conditioning Work (HVAC) and Plumbing Work).

   b. The 15300 series section numbers (Sections 15300 through 15399, inclusive) are reserved for the specification of requirements, materials, methods, and equipment specifically pertaining to fire protection work. For submittal requirements see Division 1 Section 1340.

   c. The 15400 series section numbers (Sections 15400 through 15499, inclusive) are reserved for the specification of requirements, materials, methods, and equipment specifically pertaining to plumbing work.

   d. The remaining Division 15 numbers (Sections 15500 through 15999, inclusive) are reserved for the specification of requirements, materials, methods, and equipment specifically pertaining to HVAC.

C. DEFINITIONS

1. Concealed, as used in Division 15 Specifications, shall mean located beyond immediate sight, such as in a chase or above a dropped ceiling.

2. Exposed, as used in Division 15 Specifications, shall mean not concealed.

3. Finished area, as used in Division 15 Specifications, shall mean any space intended for habitation or normal occupancy where rough surfaces are plastered, paneled, furred, or otherwise finished.

4. Unfinished area, as used in Division 15 Specifications, shall mean any space intended for storage and equipment where rough surfaces are left unfinished.

D. MISCELLANEOUS AND SPECIAL PROVISIONS

1. Additional requirements, applicable to the work of Division 15, are specified in Section 01011, MISCELLANEOUS PROVISIONS and Section 01025, SPECIAL PROVISIONS.

2. Secure necessary permits and pay all required fees applicable to the work in Division 15.

* * * * *
A. ACCEPTABLE MANUFACTURERS
   1. All piping shall be manufactured in the United States

B. GALVANIZING
   1. Galvanizing for pipe shall conform to the applicable ASTM specification for the pipe.
   2. Galvanizing for fittings and miscellaneous accessories shall conform to ASTM A 153.

C. PIPE THREADS
   1. All pipe threads on pipe, couplings, and threaded fittings shall conform to ANSI/ASME B1.20.1.

D. FLANGE GASKETS
   1. Gaskets for flanged fittings shall conform to the dimensional requirements of ANSI B16.21.
   2. Gasket materials shall be as specified for the particular piping system.

E. REINFORCED BRANCH OUTLET CONNECTIONS
   1. Reinforced branch outlet connections shall be welding fittings specifically designed to provide a branch outlet from a welded steel piping system.
   2. Fitting materials and fabrication shall conform to ASTM A 105.
   3. Outlet connections shall be of a pressure class compatible with the system in which used and shall be Bonney Forge "Weldolets" or "Thredolets," as applicable or as approved.

F. PRESSURE RATINGS
   1. Unless specifically stated otherwise, all pressure ratings listed in the following articles shall be considered to be minimum steam working pressure.

G. SYSTEM TYPE S-1 (150 PSIG, Sch-40, Screwed)
   1. Pipe
      a. Schedule 40, welded seam or seamless black steel conforming to ASTM A 53.
   2. Separable Joints
      a. Black malleable iron unions, Class 150, screwed ends, bronze-to-iron seat, spherical ground joint.
      b. Material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI B16.39.
   3. Pipe Fittings
      a. Black malleable or cast iron, Class 150, screwed ends.
      b. Malleable iron material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI/ASME B16.3.
      c. Cast iron material and fabrication to conform to ASTM A126; dimensions to conform to ANSI/ASME B16.4.
H. SYSTEM TYPE S-2 (150 PSIG, Sch-80, Screwed)

1. Pipe
   a. Schedule 80, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   a. Black malleable iron unions, Class 300, screwed ends, bronze-to-iron seat, spherical ground joint.
   b. Material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI B16.39.

3. Pipe Fittings
   a. Black malleable or cast iron, Class 300, screwed ends.
   b. Malleable iron material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI/ASME B16.3.
   c. Cast iron material and fabrication to conform to ASTM A126; dimensions to conform to ANSI/ASME B16.4.

I. SYSTEM TYPE S-3 (300 PSIG, Sch-40, Screwed)

1. Pipe
   a. Schedule 40, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   a. Black malleable iron unions, Class 300, screwed ends, bronze-to-iron seat, spherical ground joint.
   b. Material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI B16.39.

3. Pipe Fittings
   a. Black malleable or cast iron, Class 300, screwed ends.
   b. Malleable iron material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI/ASME B16.3.
   c. Cast iron material and fabrication to conform to ASTM A126; dimensions to conform to ANSI/ASME B16.4.

J. SYSTEM TYPE S-4 (125 PSIG, Sch-40, Flanged)

1. Pipe
   a. Schedule 40, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   a. Black forged steel welding neck flanges, Class 125.
   b. Material and fabrication to conform to ASTM A 105; dimensions to conform to ANSI B16.5.

3. Pipe Fittings
   a. Black wrought steel, butt welding type, of thickness to match adjoining pipe.
   b. Material and fabrication to conform to ASTM A 234; dimensions to conform to ANSI B16.9 and B16.9a.
K. SYSTEM TYPE S-5 (250 PSIG, Sch-80, Flanged)

1. Pipe
   a. Schedule 80, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   a. Black forged steel welding neck flanges, Class 250.
   b. Material and fabrication to conform to ASTM A 105; dimensions to conform to ANSI B16.5.

3. Pipe Fittings
   a. Black wrought steel, butt welding type, of thickness to match adjoining pipe.
   b. Material and fabrication to conform to ASTM A 234; dimensions to conform to ANSI B16.9 and B16.9a.

L. SYSTEM TYPE S-6 (250 PSIG, Sch-40, Flanged)

1. Pipe
   a. Schedule 40, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   a. Black forged steel welding neck flanges, Class 250.
   b. Material and fabrication to conform to ASTM A 105; dimensions to conform to ANSI B16.5.

3. Pipe Fittings
   a. Black wrought steel, butt welding type, of thickness to match adjoining pipe.
   b. Material and fabrication to conform to ASTM A 234; dimensions to conform to ANSI B16.9 and B16.9a.

M. SYSTEM TYPE S-7 (125 PSIG, Sch-40, Grooved)

1. Pipe
   a. Schedule 40, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   a. Black (may be painted) malleable iron, hinged type, grooved pipe companion flanges, Class 125, complete with bolt and gasket, Victaulic Style 741, or as approved.

3. Pipe Fittings
   a. Black (may be painted) malleable iron, ductile iron, or carbon steel, grooved ends, full flow pattern, Victaulic standard grooved end fittings, or as approved.

4. Clamps
   a. Black (may be painted) malleable iron or ductile iron, split type, rigid, bolted, gasketed, Victaulic Style 07, or as approved.

5. Gaskets
6. Clamp Bolts and Nuts
   a. Cadmium plated, track head, heat treated carbon steel, conforming to ASTM A 183.

7. Pipe Grooves
   a. All field-made pipe grooves shall be of the roll-grooved type, produced in machines specifically recommended by the clamp system manufacturer.

8. Prohibited Fittings
   a. All fittings which require a hole to be drilled, or otherwise formed, in the pipe run, such as Victaulic Styles 920 and 922.
   b. All fittings which do not specifically require a grooved end pipe, such as Victaulic "Fit," "Roust-A-Bout," and "Plainlock" Series.

N. SYSTEM TYPE S-8 (150 PSIG, Sch-40 Galv, Screwed)
   1. Pipe
      a. Schedule 40, welded seam or seamless galvanized steel conforming to ASTM A 53.

   2. Separable Joints
      a. Galvanized malleable iron unions, Class 150, screwed ends, bronze-to-iron seat, spherical ground joint.
      b. Material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI B16.39.

   3. Pipe Fittings
      a. Galvanized malleable iron, Class 150, screwed ends.
      b. Material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI/ASME B16.3.

O. SYSTEM TYPE S-9 (125 PSIG, Sch-40 Galv, Flanged)
   1. Pipe
      a. Schedule 40, welded seam or seamless galvanized steel conforming to ASTM A 53.

   2. Separable Joints
      a. Galvanized cast iron companion flanges, Class 125.
      b. Material to conform to ASTM A 126; fabrication to conform to ASTM A 48; dimensions to conform to ANSI B16.1.

   3. Pipe Fittings
      a. Galvanized malleable iron, Class 150, screwed ends.
      b. Material to conform to either ASTM A 47 or ASTM A 197; fabrication to conform to ASTM A 47; dimensions to conform to ANSI/ASME B16.3.

P. SYSTEM TYPE S-10 (125 PSIG, Sch-40 Galv, Grooved)
   1. Pipe
      a. Schedule 40, welded seam or seamless galvanized steel conforming to ASTM A 53.
2. Separable Joints
   a. Black (may be painted) malleable iron, hinged type, grooved pipe companion flanges, Class 125, complete with bolt and gasket, Victaulic Style 741, or as approved.

3. Pipe Fittings
   a. Galvanized black malleable iron or galvanized ductile iron, grooved ends, full flow pattern, Victaulic standard grooved end fittings, or as approved.

4. Clamps
   a. Black (may be painted) malleable iron or ductile iron, split type, rigid, bolted, gasketed, Victaulic Style 07, or as approved.

5. Gaskets

6. Clamp Bolts and Nuts
   a. Cadmium plated, track head, heat treated carbon steel, conforming to ASTM A 183.

7. Pipe Grooves
   a. All field-made pipe grooves shall be of the roll-grooved type, produced in machines specifically recommended by the clamp system manufacturer.

8. Prohibited Fittings
   a. All fittings which require a hole to be drilled, or otherwise formed, in the pipe run, such as Victaulic Styles 920 and 922.
   b. All fittings which do not specifically require a grooved end pipe, such as Victaulic “Fit,” “Roust-A-Bout,” and “Plainlock” Series.

Q. SYSTEM TYPE S-11 (2,500 PSIG, Sch-160, Screwed)
   1. Pipe
      a. Schedule 160, welded seam or seamless black steel conforming to ASTM A 53.
   2. Separable Joints
      a. Forged steel, screwed end flanges, Class 2500.
      b. Material to conform to ASTM A 105; fabrication to conform to ASTM A 47; dimensions to conform to ANSI B16.5.
   3. Pipe Fittings
      a. Forged steel, Class 2500, screwed ends.
      b. Material to conform to either ASTM A 105; dimensions to conform to ANSI/ASME B16.11.

R. SYSTEM TYPE S-12 (300 PSIG, Sch-40, Socket Welded)
   1. Pipe
      a. Schedule 40, welded seam or seamless black steel conforming to ASTM A 53.
   2. Separable Joints
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a. Black malleable iron unions, Class 300, screwed ends, bronze-to-iron seat, spherical ground joint.
b. Material and fabrication to conform to ASTM A 105; dimensions to conform to ANSI B16.5.

3. Pipe Fittings
   
b. Material to conform to either ASTM A 105; dimensions to conform to ANSI/ASME B16.11.

S. SYSTEM TYPE S-13 (Sch-80, Butt Welded)

1. Pipe
   
a. Schedule 80, welded seam or seamless black steel conforming to ASTM A 53.

2. Separable Joints
   
a. Forged steel weld neck flanges, Class 40.
b. Material and fabrication to conform to ASTM A 105; dimensions to conform to ANSI B16.5.

3. Pipe Fittings
   
a. Black wrought steel, butt welding type, of thickness to match adjoining pipe.
b. Material and fabrication to conform to either ASTM A 234; dimensions to conform to ANSI/ASME B16.9 and B16.9a.

* * * * *
A. **ACCEPTABLE MANUFACTURERS**  
   1. All piping shall be manufactured in the United States

B. **PIPE THREADS**  
   1. All pipe threads on tapped fittings shall conform to ANSI/ASME B1.20.1.

C. **FLANGE GASKETS**  
   1. Gaskets for flanged fittings shall conform to the dimensional requirements of ANSI B16.21.  
   2. Gasket materials shall be as specified for the particular piping system.

D. **PRESSURE RATINGS**  
   1. Unless specifically stated otherwise, all pressure ratings listed in the following articles shall be considered to be minimum steam working pressure.

E. **REINFORCED BRANCH OUTLET CONNECTIONS**  
   1. Reinforced branch outlet connections shall be bronze brazing fittings specifically designed to provide a threaded branch outlet from a copper tubing piping system.  
   2. Outlet connections shall be Bonney Forge "Brazolets," or as approved.

F. **MACHINE-FORMED BRANCH OUTLETS**  
   1. Machine-formed branch outlets shall be made by drilling a pilot hole in the pipe run and then drawing a collar from the pipe run material. The branch piping shall then be specially formed and silver brazed into the formed collar.  
   2. The drilling of the pilot hole, the drawing of the collar, and the forming of the branch pipe end shall all be done with special tools supplied by the system manufacturer.  
   3. The machine-formed branch outlet system shall be T-Drill as manufactured by G.A. Seriachius Corporation, or as approved.

G. **SYSTEM TYPE C-1 (Type L, Unions)**  
   1. Pipe  
      a. Type L copper, drawn (hard) temper, conforming to ASTM B 88.
   2. Joining Material  
      a. Tin-antimony solder, 95-5, conforming to ASTM B 32, Alloy Grade Sb5.
   3. Separable Joints  
      a. Cast bronze unions, 125 psig, solder type, bronze-to-bronze seats, conforming to ANSI B16.18.
   4. Fittings  
      a. Wrought copper, solder joint, conforming to ANSI B16.22.  
      b. Cast bronze, solder joint, conforming to ANSI B16.18.
H. SYSTEM TYPE C-2 (Type L, Flanged)
   1. Pipe
      a. Type L copper, drawn (hard) temper, conforming to ASTM B 88.
   2. Joining Material
      a. Tin-antimony solder, 95-5, conforming to ASTM B 32, Alloy Grade Sb5.
   3. Separable Joints
      a. Cast bronze flanges, 125 psig, solder type, conforming to ANSI B16.18.
   4. Fittings
      a. Wrought copper, solder joint, conforming to ANSI B16.22.
      b. Cast bronze, solder joint, conforming to ANSI B16.18.

I. SYSTEM TYPE C-3 (Type K)
   1. Pipe
      a. Type K copper, drawn (hard) temper, conforming to ASTM B 88.
   2. Joining Material
      a. Silver-copper-zinc brazing alloy, 45-30-25, Allow Grade BAg-5.
   3. Fittings
      a. Wrought copper, solder joint, conforming to ANSI B16.22.

J. SYSTEM TYPE C-4 (Type DWV)
   1. Pipe
      a. Type DWV copper, drawn (hard) temper, conforming to ASTM B 306.
   2. Joining Material
      a. Tin-antimony solder, 95-5, conforming to ASTM B 32, Alloy Grade Sb5.
   3. Separable Joints
      a. Cast bronze unions, 125 psig, solder type, bronze-to-bronze seats, conforming to ANSI B16.18.
   4. Fittings
      a. Cast bronze, drainage pattern, solder joint, conforming to ANSI B16.23.

K. SYSTEM TYPE C-5 (Sch 40)
   1. Pipe
      a. Schedule 40, copper, conforming to ASTM B42.
   2. Joining Material
      a. Silver-copper-zinc brazing alloy, 45-30-25, Allow Grade BAg-5.
3. Separable Joints
   a. Brazed unions.

4. Pipe Fittings
   a. Brazed.

b.

L. SYSTEM TYPE B-1 (Sch 40)

1. Pipe
   a. Schedule 40, brass, conforming to ASTM B43.

2. Joining Material
   a. Silver-copper-zinc brazing alloy, 45-30-25., Allow Grade BAg-5.

3. Separable Joints
   a. Brazed unions.

4. Pipe Fittings
   a. Brazed.

* * * * *
CAST IRON PIPE AND FITTINGS

A. ACCEPTABLE MANUFACTURERS
   1. All piping shall be manufactured in the United States

B. PIPE CASTING
   1. All cast iron pipe shall be centrifugally cast in metal molds to ensure uniform wall thickness.

C. COATINGS
   1. All cast iron pipe and fittings, except for System Type CI-4, shall be coated (inside and out) with coal tar pitch or equivalent coating in conformance with ASTM A 74.

D. PIPE THREADS
   1. All pipe threads on tapped fittings shall conform to ANSI/ASME B1.20.1.

E. SYSTEM TYPE CI-1 (Standard Weight, Bell & Spigot)
   1. Pipe
      a. Gray cast iron, service weight, bell and spigot configuration without bead, unlined, conforming to ASTM A 74, with bell end formed for rubber gasket.
   2. Pipe Fittings
      a. Gray cast iron, service weight, bell and spigot configuration without bead, unlined, conforming to ASTM A 74, with bell ends formed for rubber gaskets.
   3. Joint Gaskets
      a. Virgin rubber, positive seal, compression type, for push-on application conforming to ASTM C 564.

F. SYSTEM TYPE CI-2 (Heavy Weight, Bell & Spigot)
   1. Pipe
      a. Gray cast iron, extra heavy weight, bell and spigot configuration without bead, unlined, conforming to ASTM A 74, with bell end formed for rubber gasket.
   2. Pipe Fittings
      a. Gray cast iron, extra heavy weight, bell and spigot configuration without bead, unlined, conforming to ASTM A 74, with bell ends formed for rubber gaskets.
   3. Joint Gaskets
      a. Virgin rubber, positive seal, compression type, for push-on application, conforming to ASTM C 564.

G. SYSTEM TYPE CI-3 (Standard Weight, Hubless)
   1. Pipe
      a. Gray cast iron, standard weight, plain end, unlined, conforming to CISPI Standard 301.
2. Pipe Fittings
   a. Gray cast iron, standard weight, beaded end, unlined, conforming to CISPI Standard 301.

3. Pipe Joints

H. SYSTEM TYPE CI-4 (Acid Resistant, Bell & Spigot)

1. Pipe
   a. High silicone content cast iron, extra heavy weight, bell and spigot configuration with bead, unlined, conforming to ASTM A 518; Duriron, or as approved.

2. Pipe Fittings
   a. High silicone content cast iron, extra heavy weight, bell and spigot configuration with bead, unlined, conforming to ASTM A 518, joints made with acid-resistant rope and molten lead; Duriron, or as approved.

3. Rope Seal
   a. Special acid-resistant packing rope as recommended by the pipe manufacturer; Sealite Acid-Resistant Red Stripe No. 312, or as approved.

* * * * *
A. ACCEPTABLE MANUFACTURERS
   1. All piping shall be manufactured in the United States

B. PIPE CASTING
   1. All ductile iron pipe shall be centrifugally cast in metal molds to ensure uniform wall thickness.

C. EXTERNAL COATINGS
   1. All ductile iron pipe and fittings shall be externally coated coal tar pitch or equivalent coating in conformance with ANSI/AWWA C151/A21.51 and ANSI/AWWA C110/A21.10.

D. INTERNAL LININGS
   1. Ductile iron pipe and fittings specified as lined type shall be cement-mortar lined in conformance with ANSI/AWWA C104/A21.4.

E. POLYETHYLENE ENCASEMENT
   1. Polyethylene encasement shall be of the sleeve type in conformance with ANSI/AWWA C105/A21.5.

F. PIPE THREADS
   1. All pipe threads on tapped fittings shall conform to ANSI/ASME B1.20.1.

G. SYSTEM TYPE DI-1 (Bell & Spigot)
   1. Pipe
      a. Ductile cast iron, thickness Class 52, bell and spigot configuration without bead, lined, conforming to ANSI/AWWA C151/A21.51, with bell end formed for rubber gasket.
   2. Pipe Fittings
      a. Ductile cast iron, pressure Class 350, bell and spigot configuration without bead, lined, conforming to ANSI/AWWA C110/A21.10, with bell ends formed for rubber gaskets.
   3. Joint Gaskets
      a. Virgin rubber, positive seal, compression type, for push-on application, conforming to ANSI/AWWA C111/A21.11.

H. SYSTEM TYPE DI-2 (Mechanical Joint, Lined)
   1. Pipe
      a. Ductile cast iron, thickness Class 52, mechanical joint configuration, lined, conforming to ANSI/AWWA C151/A21.51.
   2. Pipe Fittings
      a. Ductile cast iron, pressure Class 350, mechanical joint configuration, lined, conforming to ANSI/AWWA C110/A21.10.
3. Joint Gaskets
   a. Virgin rubber, positive seal, compression type, for mechanical joint application, conforming to ANSI/AWWA C111/A21.11.

I. SYSTEM TYPE DI-3 (Mechanical Joint, Unlined)

1. Pipe
   a. Ductile cast iron, thickness Class 52, mechanical joint configuration, unlined, conforming to ANSI A21.52.

2. Pipe Fittings

3. Joint Gaskets
   a. Virgin rubber, positive seal, compression type, for mechanical joint application, conforming to ANSI/AWWA C111/A21.11.

* * * * *
A. ACCEPTABLE MANUFACTURERS
   1. All piping shall be manufactured in the United States.

B. PLASTIC MATERIALS
   1. Polyvinyl chloride (PVC) plastic shall be Class 12454-B, conforming to ASTM D 1784.
   2. Chlorinated polyvinyl chloride (CPVC) plastic shall be Class 23447-B, conforming to ASTM D 1784.
   3. Flame retardant polypropylene (PPFR) plastic shall be Class 29209, conforming to ASTM D 4101.
   4. Polyvinylidine fluoride (PVDF) plastic shall be Nibco Kem-Temp, or as approved.
   5. Polyethylene (PE) shall be PE 3408-SDR11 conforming to ASTM D3350.

C. PIPE THREADS
   1. All pipe threads on threaded fittings and adaptors shall conform to ANSI/ASME B1.20.1.

D. PIPE FLANGES
   1. All flange dimensions and drillings shall conform to ANSI B16.5 for Class 125 flanges.

E. FLANGE GASKETS
   1. Gaskets for flanged fittings shall conform to the dimensional requirements of ANSI B16.21.
   2. Gasket materials shall be as specified for the particular piping system.

F. PRESSURE RATINGS
   1. Unless specifically stated otherwise, all pressure ratings listed in the following articles shall be considered to be for nonshock cold water service.

G. SYSTEM TYPE P-1 (PVC, Sch-40)
   1. Pipe
      a. Schedule 40 PVC, conforming to ASTM D 1785.
   2. Separable Joints in Piping 2 Inches and Smaller
      a. Schedule 80 PVC unions, plastic-to-plastic seat, o-ring seal, socket ends, Nibco Figure 4533, or as approved.
   3. Separable Joints in Piping 2-1/2 Inches and Larger and at Flanged Equipment
      a. Schedule 80 PVC flanges, socket end, Nibco Figure 4551, or as approved.
   4. Pipe Joining Method
      a. Solvent welding, utilizing solvent cement conforming to ASTM D 2564.
   5. Pipe Fittings
a. Schedule 40 PVC, socket ends, conforming to ASTM D 2466.

H. SYSTEM TYPE P-2 (PVC, Sch-80)

1. Pipe
   a. Schedule 80 PVC, conforming to ASTM D 1785.

2. Separable Joints in Piping 2 Inches and Smaller
   a. Schedule 80 CPVC unions, plastic-to-plastic seat, o-ring seal, socket ends, Nibco Figure 4533, or as approved.

3. Separable Joints in Piping 2-1/2 Inches and Larger and at Flanged Equipment
   a. Schedule 80 PVC flanges, socket end, Nibco Figure 4551, or as approved.

4. Pipe Joining Method
   a. Solvent welding, utilizing solvent cement conforming to ASTM D 2564.

5. Pipe Fittings
   a. Schedule 80 PVC, socket ends, conforming to ASTM D 2467.

I. SYSTEM TYPE P-3 (CPVC, Sch-40)

1. Pipe
   a. Schedule 40 CPVC, conforming to ASTM F 441.

2. Separable Joints in Piping 2 Inches and Smaller
   a. Schedule 80 CPVC unions, plastic-to-plastic seat, o-ring seal, socket ends, Nibco Figure 5133, or as approved.

3. Separable Joints in Piping 2-1/2 Inches and Larger and at Flanged Equipment
   a. Schedule 80 CPVC flanges, socket end, Nibco Figure 5151, or as approved.

4. Pipe Joining Method
   a. Solvent welding, utilizing solvent cement conforming to ASTM F 493.

5. Pipe Fittings
   a. Schedule 40 CPVC, socket ends, conforming to ASTM F 438.

J. SYSTEM TYPE P-4 (CPVC, Sch-80)

1. Pipe
   a. Schedule 80 CPVC, conforming to ASTM F 441.

2. Separable Joints in Piping 2 Inches and Smaller
   a. Schedule 80 PVC unions, plastic-to-plastic seat, o-ring seal, socket ends, Nibco Figure 5133, or as approved.

3. Separable Joints in Piping 2-1/2 Inches and Larger and at Flanged Equipment
   a. Schedule 80 CPVC flanges, socket end, Nibco Figure 5151, or as approved.
4. Pipe Joining Method
   a. Solvent welding, utilizing solvent cement conforming to ASTM F 493.

5. Pipe Fittings
   a. Schedule 80 CPVC, socket ends, conforming to ASTM F 439.

K. SYSTEM TYPE P-5 (PVDF, Sch-80)
   1. Pipe
      a. Schedule 80 PVDF.
   2. Separable Joints in Piping 2 Inches and Smaller
      a. Schedule 80 PVDF unions, plastic-to-plastic seat, o-ring seal, socket ends, Nibco Figure 6533, or as approved.
   3. Separable Joints in Piping 2-1/2 Inches and Larger and at Flanged Equipment
      a. Schedule 80 PVDF flanges, socket end, Nibco Figure 6551, or as approved.
   4. Pipe Joining Method
      a. Thermo-seal fusion welding.
   5. Pipe Fittings
      a. Schedule 80 PVDF, socket ends, pressure pattern.

L. SYSTEM TYPE P-6 (PVC, DWV)
   1. Pipe
      a. DWV weight PVC, conforming to ASTM D 2665.
   2. Pipe Joining Method
      a. Solvent welding, utilizing solvent cement conforming to ASTM D 2564.
   3. Pipe Fittings
      a. DWV weight PVC, drainage pattern, conforming to ASTM D 2665 and ASTM D 3311.

M. SYSTEM TYPE P-7 (PPFR, Sch-40)
   1. Pipe
      a. Schedule 40 PPFR, GSR Fuseal, or as approved.
   2. Separable Joints
      a. Mechanical joint coupling, compression type, GSR Fuseal Part No. 9001 or 9002, as applicable, or as approved.
   3. Pipe and Fitting Joining Method
      a. Heat fusion, utilizing embedded electric resistance coils, GSR Fuseal, or as approved.
   4. Pipe Fittings
      a. Schedule 40 PPFR, drainage pattern, socket ends, with coils, GSR Fuseal, or as approved.
N. SYSTEM TYPE P-8 (PE, Sch-40)

1. Pipe
   a. Schedule 40 PE 3408, high density polyethylene, Phillips Driscopipe 8600.

2. Separable Joints
   a. Schedule 40 PE flanges, butt fusion.

3. Pipe Joining Method
   a. Heat fusion welding.

4. Pipe Fittings
   a. Schedule 40 PE, butt fusion.

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SECTION 15068
STAINLESS STEEL PIPE AND FITTINGS

A. ACCEPTABLE MANUFACTURERS
1. All piping shall be manufactured in the United States.

B. PIPE THREADS
1. All pipe threads on pipe, couplings, and threaded fittings shall conform to ANSI/ASME B1.20.1.

C. PRESSURE RATINGS
1. Unless specifically stated otherwise, all pressure ratings listed in the following articles shall be considered to be minimum steam working pressure.

D. SYSTEM TYPE SS-1 (300 PSIG, Compression Fittings)
1. Tubing
   a. Seamless 316 or 316L stainless steel tubing, 1-inch I.D., minimum wall thickness 0.22 inches.
   b. Material to conform to ASTM A269.
2. Separable Joints
   a. Sealed quick-connect stainless steel fittings.
   b. Swagelok OTM Series.
3. Tubing Fittings
   a. Sealed quick-connect stainless steel fittings.
   b. Swagelok OTM Series.

E. SYSTEM TYPE SS-2 (150 PSIG, Sch-40, Screwed)
1. Pipe
   a. Schedule 40S, welded seam or seamless stainless steel.
   b. Material to conform to ASTM 312, Grade TP304; fabrication to conform to ASTM 312; dimensions to conform to ANSI/ASME B36.19.
2. Separable Joints
   a. Cast stainless steel unions, Class 150, screwed ends, stainless steel to stainless steel seat, spherical ground joint.
   b. Material to match associated piping; dimensions to conform to ANSI B16.39.
3. Pipe Fittings
   a. Cast stainless steel, 150 psig, screwed ends.
   b. Material to match associated piping; dimensions to conform to ANSI/ASME B16.3.

F. SYSTEM TYPE SS-3 (3,500 PSIG, Sch-80, Welded)
1. Pipe
   a. Schedule 80, welded seam or seamless stainless steel.
   b. Material to conform to ASTM 312, Grade TP304; fabrication to conform to ASTM 312; dimensions to conform to ANSI/ASME B36.19.
2. Separable Joints
   a. Class 6000, socketweld, 304 stainless steel,
      CPV O- Seal, Model 51, BanaN O ring, with monel union nut.

3. Pipe Fittings
   a. Class 6000, socketweld, 304 stainless steel

G. SYSTEM TYPE SS-4  (6,000 PSIG, Sch-160, Screwed)

1. Pipe
   a. Schedule 160, welded seam or seamless stainless steel.
   b. Material to conform to ASTM 312, Grade TP304; fabrication to conform to ASTM 312;
      dimensions to conform to ANSI/ASME B36.19.

2. Separable Joints
   a. Class 6000, socketweld, 304 stainless steel,
      CPV O- Seal, Model 51, BanaN O ring, with monel union nut.

3. Pipe Fittings
   a. Class 6000, socketweld, 304 stainless steel

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SECTION 15070

SPECIAL UNDERGROUND PIPING SYSTEMS

A. ACCEPTABLE MANUFACTURERS
   1. Rovanco Corporation.
   2. Perma-Pipe.
   3. Ric-Wil.
   4. Or as approved.

B. GENERAL
   1. The preinsulated, below grade piping system shall be a pre-engineered, sectional, factory fabricated system consisting of carrier pipe, pipe insulation, insulation jacketing materials, and all required anchors, end fittings, wall seals, expansion provisions, and field joining materials.
   2. Preinsulated, below grade piping system shall be designed for below grade 200 psig distribution.
   3. All insulation and accessories shall have component fire hazard classification not to exceed flame spread -25 and smoke developed -50 when tested in accordance with ASTM Specification E-84.
   4. Underground piping systems shall be Rovanco Insul-8, or as approved.

C. CARRIER PIPE AND FITTINGS
   1. Pipe and fittings for compressed air (125 PSIG maximum) shall be copper, System Type C-1, or steel, System Type S-4.
   2. Pipe and fittings for chilled water shall be steel, System Type S-4.
   3. Pipe and fittings for steam and condensate shall be steel, System Type S-5.

D. INSULATION
   1. GENERAL: Insulation shall be minimum 1-1/2 inch thick urethane foam or mineral wool.
   2. DENSITY: 2 pounds/cubic foot (minimum).
   3. THERMAL CONDUCTIVITY: 0.16 BTU/hour/square foot/F/inch (maximum) at 70 degrees F.
   4. MOISTURE ABSORPTION: 8.05 grams/thousand cubic centimeters when tested in accordance with ASTM D-2127.
   5. COMPRESSIVE YIELD: 33 pounds per cubic foot.
   6. OPERATING TEMPERATURE RANGE: -350 to 300 degrees F.
   7. FIRE RATING: Not to exceed flame spread -1400 and smoke developed -450 when tested in accordance with ASTM Specification E-84.

E. INSULATION JACKETING MATERIAL
   1. Insulation jacket shall be minimum 110 mil thick, seamless, solid wall polyvinyl chloride jacket for all services except steam and condensate which shall have steel outer jackets.
   2. Ends of jacket shall be provided with a factory installed end seal bonded to both the carrier pipe and the jacket forming a water-tight seal.
F. EXPANSION COMPENSATION

1. All expansion compensation devices including expansion elbows, pipe guides, and anchors shall be factory fabricated by the piping manufacturer.

2. Expansion elbows shall consist of a factory fabricated, oversized insulation jacket to permit the carrier pipe to move without damaging the insulation or the insulation jacket.

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DIVISION 15 - 48
SECTION 15075

DIELECTRIC PIPING CONNECTIONS

A. ACCEPTABLE MANUFACTURERS

1. Dielectric Unions and Flanges
   a. Watts Regulator Company.
   b. Epco Sales Incorporated.
   c. Or as approved.

2. Dielectric Waterways
   a. Perfection Corporation.
   b. Or as approved.

B. DIELECTRIC UNIONS

1. Dielectric unions shall consist of one screwed end, malleable iron body half and one solder end brass body half, joined together with a malleable iron union nut. The brass and malleable iron halves shall be separated by a dielectric gasket and the union nut shall be dielectrically isolated from the brass body half.

2. Dielectric unions shall have a minimum pressure rating of 250 psig.

3. Gasket material shall be as recommended by the manufacturer for the particular application.

4. Dielectric unions shall be Watts No. 3001 Series, or as approved.

C. DIELECTRIC FLANGES

1. Dielectric flanges shall consist of one screwed end, cast iron pipe flange and one solder end cast bronze pipe flange, joined together with cadmium plated steel bolts and nuts. The flanges shall be separated by a dielectric gasket and the bolts shall be dielectrically isolated from both flanges.

2. Dielectric flanges shall have a minimum pressure rating of 175 psig.

3. Gasket material shall be as recommended by the manufacturer for the particular application.

4. Dielectric flanges shall be Watts No. 3100 Series, or as approved.

D. DIELECTRIC WATERWAYS

1. Dielectric waterways shall consist of a galvanized pipe nipple with a locked-in thermoplastic liner. Liner shall be National Sanitation Foundation and U.S. Food and Drug Administration approved. Nipple shall have one threaded end and one grooved end.

2. Dielectric waterways shall be Clear Flow Products, as manufactured by Perfection Corporation, or as approved.

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SECTION 15081

PIPE HANGERS AND SUPPORTS

A. ACCEPTABLE MANUFACTURERS

1. B-Line Systems, Inc.

2. Michigan Hanger Company, Inc. (Pending Electric Boat Approval)

3. Carpenter and Paterson, Inc. (Pending Electric Boat Approval)

4. Elcen Metal Products Company. (Pending Electric Boat Approval)

B. GENERAL

1. The following paragraphs list those products which are normally used on the piping systems. Other standard products of the acceptable manufacturers may be used where conditions require other than these products.

C. BAND HANGERS

1. Band hangers shall be of the adjustable type, steel construction, plain or copper-coated finish (as applicable), complete with upper and lower locknuts, B-Line Figure B3172 or Figure B3172CT, as applicable, or as approved.

D. CLEVIS HANGERS

1. Clevis hangers shall be of the adjustable type, steel construction, plain finish, with through-bolt connecting upper and lower yokes, complete with upper and lower locknuts.

2. Standard weight clevis hangers shall be B-Line Figure B3100, or as approved.

3. Extra heavy clevis hangers shall be B-Line Figure B3102, or as approved.

4. Clevis hangers for continuously supported plastic pipe shall be of light weight construction and shall have the bottom yoke formed to match the pipe support channel. Hangers shall be B-Line Figure B3106, or as approved.

E. ROLLER HANGERS

1. Roller hangers shall be of the adjustable type, steel upper yoke with cast iron roller, plain finish, with through-bolt roller axle, complete with upper and lower locknuts, B-Line Figure B3110, or as approved.

F. CONSTANT SUPPORT HANGERS

1. Constant support hangers shall be of the spring compensated type designed to maintain a constant support load regardless of vertical piping movement.

2. Constant support hangers shall be of the adjustable type with integral load adjustment scale. Each constant support hanger shall be factory calibrated for the actual unit load. Factory calibrations shall be stamped on the unit’s load adjustment scale. Factory settings shall allow for a minimum of 10 percent adjustability on either side of the factory setting. Field load adjustments shall not require the use of any special tools and shall not impact on the travel capabilities of the support.

3. Constant support hangers shall include integral travel scales on both sides of the hanger to allow for inspection.

4. Hanger springs shall conform to the requirements of ASTM A-125. Spring tolerance range shall be $\pm 5$ percent.
5. Constant supports shall be furnished with travel stops which shall prevent upward and downward movement of the hanger. The travel stops will be factory installed so that the hanger level is at the “cold” position. The travel stops will be of such design as to permit future re-engagement, even in the event the lever is at a position other than “cold”, without having to make hanger adjustments.

6. The total travel for constant support hangers will be equal to actual travel plus 20 percent. In no case will the difference between actual and total travel be less than 1 inch.

7. Constant support hangers shall be Grinnell Figure 80-V or 80-H, as applicable, or as approved.

G. INSULATION SHIELDS

1. Insulation shields shall be curved to match the outside diameter of the pipe insulation, steel construction, galvanized finish, B-Line Figure B3151, or as approved.

2. Shield gauge and length shall be not less than the recommendations of B-Line Systems, Inc., for the pipe size and insulation thickness being supported.

H. PROTECTION SADDLES

1. Saddles shall be of curved, steel construction, plain finish, designed to match thickness of adjacent insulation, B-Line Figure B3160, or as approved.

I. PLASTIC PIPE SUPPORT CHANNEL

1. Plastic pipe support channel shall be of galvanized steel construction of not less than 18 gauge thickness, shall be of a V configuration, and shall be continuous between hangers. Support channel shall be B-Line Figure B3106V, or as approved.

J. RISER CLAMPS

1. Riser clamps shall be of steel construction, plain finish, two-piece type, B-Line Figure B373, or as approved.

K. UPPER ATTACHMENTS FOR CONCRETE CONSTRUCTION

1. Concrete inserts shall be of the continuous channel type, steel construction, plain finish, complete with end caps and filler strips, B-Line Figure B22I, or as approved.

2. Expansion shields shall be of the two-piece, self-drilling type, steel construction, plain finish, as manufactured by Phillips, or as approved.

L. UPPER ATTACHMENTS FOR STEEL CONSTRUCTION

1. Beam clamps shall be of the adjustable type, malleable iron construction, plain finish, B-Line Figure B3054, or as approved.

2. C-clamps shall be of malleable iron construction, plain finish, with locknut, and complete with retaining strap. Assembly shall consist of B-Line Figure B3036L clamp plus Figure B352 strap, or as approved.

M. FLOOR STANDS

1. Floor stands shall be constructed of Schedule 40 steel pipe, structural steel, or factory fabricated steel supports.

2. Threaded rod shall not be used for floor stand supports.

N. HANGER ROD

1. Hanger rod shall be steel, plain finish, full threaded type, B-Line Figure ATR, or as approved.
SECTION 15082

PIPE ANCHORS AND GUIDES

A. ACCEPTABLE MANUFACTURERS

1. Carpenter and Paterson, Inc.


3. Or as approved.

B. PIPE ANCHORS

1. Welded type anchors shall be of the chair type, carbon steel construction, and designed to be welded directly to the pipe and bolted or welded to the structure. Anchors shall be Carpenter and Paterson Figure 376, or as approved.

2. Bolted type anchors shall be of the chair type, carbon steel construction, designed so that the pipe is clamped to the anchor by means of a U-bolt, and the anchor is bolted or welded to the structure. Anchors shall be Carpenter and Paterson Figure 127, or as approved.

3. Soldered type anchors shall be of the chair type, copper construction, and designed to be soldered or brazed directly to the pipe and bolted to the structure. Anchors shall be Keflex Type BA, or as approved.

C. PIPE GUIDES

1. Pipe guides for general use shall be of the spider type with a two piece internal spider sliding in a stationary two piece outer body. Guides shall be of carbon steel construction and shall be Carpenter and Paterson Figure 1007, Keflex Type CP, or as approved.

2. Pipe guides for use inside fin radiation enclosure shall be of the teflon-lined clamping type of steel or copper construction, as applicable, and shall be Keflex Type B, or as approved.

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SECTION 15083

PIPING CONSTRUCTION PENETRATIONS

A. ACCEPTABLE MANUFACTURERS

1. Waterproof Seals
   a. Thunderline Corporation.
   b. Or as approved.

2. Escutcheons
   b. Or as approved.

3. Pipe Curb Assemblies
   a. The Pate Company.
   b. Or as approved.

B. PIPE SLEEVES

1. Sheet metal sleeves shall be constructed of galvanized sheet metal and shall be provided with means
   for holding the sleeve securely in the penetrated construction.

2. Steel pipe sleeves shall be constructed of Schedule 40 black steel pipe and shall be provided with
   means for holding the sleeve securely in the penetrated construction.

3. Waterproof sleeves shall be constructed of Schedule 40 black steel pipe and shall be provided with a
   welded steel waterstop projecting at least two inches from the pipe in all directions.

C. WATERPROOF SEALS

1. Waterproof seals shall be of molded rubber construction, designed to be expanded radially by
   mechanical compression longitudinally and shall be Thunderline Corporation Linkseals, or as
   approved.

D. ESCUTCHEONS

1. Escutcheons shall be of cast brass construction, split type with set screw, Beaton and Corbin No. 3 or
   No. 24 (as applicable), or as approved.

E. FIRESTOP SEALANT SYSTEMS

1. Firestop sealant systems shall be as specified in Section 07270, FIRESTOPPING.

F. PIPE CURB ASSEMBLIES

1. Pipe curb assemblies shall consist of a roof curb and a matching piping penetration cap with all
   necessary accessories.

2. Roof curbs shall be of heavy gauge galvanized steel construction, shall be of box section design with
   integral base plate and shall have continuously welded corner seams.

3. Piping penetration cap shall be of ABS plastic construction, shall include knockouts for four pipes,
   shall be designed to act as a counterflashing, and shall be complete with four boot and clamp
   assemblies.

4. Boots shall be of a graduated step design to accommodate a range of pipe sizes and shall be of PVC
   construction.
5. Clamps shall be of stainless steel construction, shall be adjustable, and shall be sized for the application.

6. Pipe curb assemblies shall be Pate Model PCA-2, or as approved.

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SECTION 15101
GATE VALVES

A. ACCEPTABLE MANUFACTURERS
1. Nibco Incorporated.
2. ITT Grinnell.
3. Milwaukee Valve Company, Inc.

B. GENERAL
1. Valves shall include a gland follower and packings shall be selected for the applicable service.
2. All gate valves shall be provided with backseating design to protect both the packing and the stem threads from the fluid being conveyed when the valve is in the full open position.
3. All valve stem materials shall be selected specifically to minimize dezincification.
4. All valves shall be “Industrial Duty” unless otherwise specified.

C. MANUAL VALVE OPERATORS
1. All valves 2 inches and smaller shall be provided with an aluminum alloy or malleable iron handwheel, whichever is standard with the manufacturer.
2. All valves 2-1/2 inches and larger, installed more than 8 feet above the finished floor, shall be provided with a chain wheel and chain for easy operation from floor level. Chain wheel for valves 6 inches and larger shall be of the hammer-blow type.
3. All valves 2-1/2 inches and larger, installed 8 feet or less above the finished floor, shall be provided with a cast iron handwheel.

D. VALVE TYPE GT-1 (125 PSIG, Screwed)
1. Valves shall be of the bronze body, bronze mounted type with solid wedge disc, union bonnet, rising stem, and screwed ends.
2. Valves shall have a SWP pressure rating of not less than 150 psig and a WOG pressure rating of not less than 300 psig.
3. Valves shall be Nibco Model T-134, or as approved.

E. VALVE TYPE GT-2 (300 PSIG, Screwed)
1. Valves shall be of the bronze body, bronze mounted type with solid wedge disc, union bonnet, rising stem, and screwed ends.
2. Valves shall have a SWP pressure rating of not less than 300 psig.
3. Valves shall be Nibco Model T-174-A, or as approved.

F. VALVE TYPE GT-3 (175 PSIG, Sprinkler Systems)
1. Valves shall be of the bronze body, bronze mounted type with solid wedge disc, screw-over bonnet, screwed ends, and outside screw and yoke.
2. Valves shall be UL listed and FM approved.
3. Valves shall have a WOG pressure rating of not less than 175 psig.
4. Valves shall be Nibco Model T-104-0, or as approved.

G. VALVE TYPE GT-4  (125 PSIG, Flanged)
1. Valves shall be of the iron body, bronze mounted type with solid wedge disc, replaceable trim, bolted bonnet, outside screw and yoke, and flanged ends.
2. Valves shall have a SWP pressure rating of not less than 125 psig and a WOG pressure rating of not less than 200 psig.
3. Valves shall be Nibco Model F-617-0, or as approved.

H. VALVE TYPE GT-5  (250 PSIG, Flanged)
1. Valves shall be of the iron body, bronze mounted type with solid wedge disc, replaceable trim, bolted bonnet, outside screw and yoke, and flanged ends.
2. Valves shall have a SWP pressure rating of not less than 250 psig.
3. Valves shall be Nibco Model F-667-0, or as approved.

I. VALVE TYPE GT-6  (175 PSIG, Sprinkler Systems)
1. Valves shall be of the iron body, bronze mounted type with solid wedge disc, replaceable trim, bolted bonnet, outside screw and yoke, and flanged ends.
2. Valves shall be UL listed and FM approved.
3. Valves shall have a WOG pressure rating of not less than 175 psig.
4. Valves shall be Crane No. 467, or as approved.

J. VALVE TYPE GT-7  (600 PSIG, Flanged)
1. Valve shall be cast steel, bronze mounted type with solid wedge disc, replaceable trim, bolted bonnet, outside screw and yoke, flanged ends, and one valve bypass.
2. Valves shall have a SWP pressure rating of not less than 600 psig and maximum operating temperature of 850° F.
3. Valves shall be Nibco Model No. CS-602-U, or as approved.

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GLOBE VALVES

A. ACCEPTABLE MANUFACTURERS
1. Nibco Incorporated.
2. ITT Grinnell.
3. Milwaukee Valve Company, Inc.
5. Honeywell

B. GENERAL
1. Valves shall include a gland follower and packings shall be selected for the applicable service.
2. All globe valves shall be provided with backseating design to protect both the packing and the stem threads from the fluid being conveyed when the valve is in the full open position.
3. All valve stem materials shall be selected specifically to minimize dezincification.
4. All valves shall be “Industrial Duty” unless otherwise specified.

C. MANUAL VALVE OPERATORS
1. All valves 2 inches and smaller shall be provided with an aluminum alloy or malleable iron handwheel whichever is standard with the manufacturer.
2. All valves 2-1/2 inches and larger, installed more than 8 feet above the finished floor, shall be provided with a chain wheel and chain for easy operation from floor level. Chain wheel for valves 6 inches and larger shall be of the hammer-blow type.
3. All valves 2-1/2 inches and larger, installed 8 feet or less above the finished floor, shall be provided with a cast iron handwheel.

D. VALVE TYPE GL-1 (150 PSIG, Screwed)
1. Valves shall be of the bronze body, bronze mounted type, globe or angle pattern, with teflon disc, union bonnet, rising stem, and screwed ends.
2. Valves shall have a SWP pressure rating of not less than 150 psig and a WOG pressure rating of not less than 300 psig.
3. Globe valves shall be Nibco Model T-235-Y, or as approved.
4. Angle valves shall be Nibco Model T-335-Y, or as approved.

E. VALVE TYPE GL-2 (300 PSIG, Screwed)
1. Valves shall be of the bronze body, bronze mounted type, globe pattern, with teflon disc, union bonnet, rising stem, and screwed ends.
2. Valves shall have a SWP pressure rating of not less than 300 psig.
3. Valves shall be Nibco Model T-275-Y, or as approved.

F. VALVE TYPE GL-3 (125 PSIG Flanged)
1. Valves shall be of the iron body, bronze mounted type, globe or angle pattern, with bronze disc, replaceable trim, bolted bonnet, outside screw and yoke, and flanged ends.

2. Valves shall have a SWP pressure rating of not less than 125 psig and a WOG pressure rating of not less than 200 psig.

3. Globe valves shall be Nibco Model F-718-B, or as approved.

4. Angle valves shall be Nibco Model F-818-B, or as approved.

G. VALVE TYPE GL-4  (250 PSIG, Flanged)

1. Valves shall be of the iron body, bronze mounted type, globe pattern, with bronze disc, replaceable trim, bolted bonnet, outside screw and yoke, and flanged ends.

2. Valves shall have a SWP pressure rating of not less than 250 psig.

3. Valves shall be Nibco Model F-768-B, or as approved.

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SECTION 15103
BALL VALVES

A. ACCEPTABLE MANUFACTURERS

1. Metal Valves
   a. Nibco Incorporated.
   b. ITT Grinnell.
   c. Watts Regulator Company.
   d. Jamesbury.
   e. Apollo (Conbraco).

2. Plastic Valves
   a. Nibco Incorporated.
   b. Asahi/America, Incorporated.
   c. Hayward.

B. GENERAL

1. All ball valves shall be of the quarter turn to full open type.
2. All ball valves shall have replaceable valve seats, ball, and stem.
3. Ball valves installed in vacuum applications shall be full port type.
4. All valves shall be “Industrial Duty” unless otherwise specified.

C. VALVE HANDLES, METAL VALVES

1. Valves for use in uninsulated lines shall have lever type handles.
2. Valves for use in insulated lines shall have extended tee handles to accommodate thermal insulation up to 2 inches in thickness. Handle shall have an open center to allow access to the packing gland adjustment.
3. All handles shall align with the piping when the valve is in the full open position.
4. Valves used for balancing shall include a memory stop feature to allow the valve to be closed and reopened to a preset position.

D. VALVE HANDLES, PLASTIC VALVES

1. Handles shall be of the tee type.
2. All handles shall align with the piping when the valve is in the full open position.

E. VALVE TYPE B-1 (400 PSIG, 2-Piece)

1. Valves shall be of the two-piece, conventional port type with bronze body, stainless steel ball, stainless steel stem, teflon seats, blowout-proof stem design, and adjustable packing gland.
2. Valves shall have a WOG pressure rating of not less than 400 psig.
3. Solder end valves shall be Nibco Model S-580-66 or Model S-580-66-M, as applicable, or as approved.
4. Screwed end valves shall be Nibco Model T-580-66 or Model T-580-66-M, as applicable, or as approved.
F. VALVE TYPE B-2 (600 PSIG, 3-Piece, Full Port)

1. Valves shall be of the three-piece, full port type with bronze body, stainless steel ball, stainless steel stem, teflon seats, blowout-proof stem design, and adjustable packing gland.

2. Valves shall have fluorocarbon rubber o-ring seals at the end pieces; end pieces shall be held together with zinc plated steel bolts and nuts.

3. Valves shall have a WOG pressure rating of not less than 600 psig.

4. Solder end valves shall be Nibco Model S-595-Y-66 or S-595-Y-66-M, as applicable, or as approved.

5. Screwed end valves shall be Nibco Model T-595-Y-66 or T-595-Y-66-M, as applicable, or as approved.

G. VALVE TYPE B-3 (150 PSIG, 3-Piece, Plastic Systems)

1. Valves shall be of the three-piece, full port, true union type with plastic body, plastic ball, plastic stem, teflon seats, blowout-proof stem design, and o-ring stem seal.

2. Valves shall have o-ring seals at the end connection pieces.

3. All plastic parts shall be comparable to the piping system in which the valve is installed.

4. Valves shall have end connections compatible with the joining method specified for the piping system in which the valve is installed.

5. Valves shall have a pressure rating (nonshock) of not less than 150 psig when handling fluids or gases at or below 70 degrees F.

6. Valves shall be Nibco Duo-Bloc, or as approved.

H. VALVE TYPE B-4 (1500 PSIG, 2-Piece, Stainless Steel Systems)

1. Valves shall be of the two-piece, conventional port type with stainless steel body, stainless steel ball, stainless steel stem, teflon seats, blowout-proof stem design, adjustable packing gland, and screwed ends.

2. Valves shall have a WOG pressure rating of not less than 1500 psig.

3. Valves shall be Nibco Model T-580-S6-R-66 or T-580-S6-R-66-M, as applicable, or as approved.

I. VALVE TYPE B-5 (400 PSIG, 2-Piece, Fuel Gas Systems)

1. Valves shall be of the two-piece, conventional port type with brass body, stainless steel ball, teflon seats, blowout-proof stem design, teflon stem seal and screwed ends.

2. Valves shall be UL listed for gas service.

3. Valves shall have a WOG pressure rating of not less than 400 psig.

4. Valves shall be Jamesbury Model 21-11, or as approved.

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SECTION 15104

BUTTERFLY VALVES

A. ACCEPTABLE MANUFACTURERS

1. Nibco Incorporated.
2. ITT Grinnell.
3. Crane Company.
6. Apollo (Conbraco).

B. GENERAL

1. All butterfly valves shall be of the quarter turn to full open type.
2. All butterfly valves shall have replaceable stem seals, stems, and discs.
3. All butterfly valves shall be of the extended neck configuration to accommodate insulation thicknesses of up to 2 inches.
4. All butterfly valves shall be provided with external disc position indicators.
5. All valves shall be “Industrial Duty” unless otherwise specified.

C. MANUAL VALVE OPERATORS, METAL VALVES

1. All valves 6 inches and larger, all valves installed more than 8 feet above the finished floor (regardless of size), and all valves used in fire protection systems shall be provided with self-locking worm gear type operators complete with indicating dial.
2. Gear type operators on valves installed more than 8 feet above the finished floor shall be provided with a chain wheel and chain for easy operation from floor level; all others shall be provided with a hand wheel.
3. All valves 4 inches and smaller installed 8 feet or less above the finished floor, except those used in fire protection systems, shall be provided with lever-lock handles complete with throttling plate and position lock.
4. All valves used for balancing shall be provided with memory stop devices to allow the valve to be reopened to a preset position after closing.

D. VALVE TYPE BF-1 (200 PSIG, 150 Degree F, Wafer)

1. Valves shall be of the wafer type with ductile iron body, aluminum-bronze disc, stainless steel stem, Buna-N seals, and Buna-N liner.
2. Valves shall have a WOG pressure rating of not less than 200 psig.
3. Valves shall be Nibco Model WD 2100, or as approved.

E. VALVE TYPE BF-2 (200 PSIG, 150 Degree F, Lug)

1. Valves shall be of the lug type with ductile iron body, aluminum-bronze disc, stainless steel stem, Buna-N seals, and Buna-N liner.
2. Valves shall have a WOG pressure rating of not less than 200 psig.

3. Valves shall be Nibco Model LD 2100, or as approved.

F. VALVE TYPE BF-3 (200 PSIG, 200 Degree F, Wafer)
   1. Valves shall be of the wafer type with ductile iron body, aluminum-bronze disc, stainless steel stem, EPDM seals, and EPDM liner.
   2. Valves shall have a WOG pressure rating of not less than 200 psig.
   3. Valves shall be Nibco Model LD 2000, or as approved.

G. VALVE TYPE BF-4 (200 PSIG, 200 Degree F, Lug)
   1. Valves shall be of the lug type with ductile iron body, aluminum-bronze disc, stainless steel stem, EPDM seals, and EPDM liner.
   2. Valves shall have a WOG pressure rating of not less than 200 psig.
   3. Valves shall be Nibco Model WD 2000, or as approved.

H. VALVE TYPE BF-5 (250 PSIG, Wafer, Sprinkler Systems)
   1. Valves shall be of the wafer type with ductile iron body, nickel plated ductile iron disc, stainless steel stem, Buna-N seals, and Buna-N liner.
   2. Valves shall be UL listed and FM approved.
   3. Valves shall have a WOG pressure rating of not less than 250 psig.
   4. Valves shall be provided with gear type operators with an integral tamper switch regardless of valve size.
   5. Valves shall be Nibco Model WD 3510-4, or as approved.

I. VALVE TYPE BF-6 (635 PSIG, Wafer, Fuel Gas Systems)
   1. Valves shall be of the wafer type with carbon steel body, stainless steel disc, stainless steel stem, and PFTE seal.
   2. Valves shall have a WOG pressure rating of no less than 635 psig, and maximum operating temperature of 400° F.
   3. Valves shall be Jamesbury Series 830, ANSI Class 300, or as approved.

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SECTION 15105
LUBRICATED PLUG COCKS AND VALVES

A. ACCEPTABLE MANUFACTURERS
   1. Olson Technologies, Homestead & Mosser Valves.
   3. The Wm. Powell Company.
   4. Or as approved.

B. GENERAL
   1. All lubricated plug cocks and all two-port lubricated plug valves shall be of the quarter turn to full open type; multi-port lubricated plug valves shall be of the quarter turn or half turn type, as applicable for the intended function.
   2. All lubricated plug valves shall be factory adjusted and shall be fully adjustable under pressure in the field.
   3. Each cock and valve shall be provided complete with an initial charge of sealant and enough spare sealant (in stick form) for one field charge.

C. MANUAL OPERATORS
   1. All cocks shall be wrench operated and shall be provided complete with a removable wrench.
   2. All lubricated plug valves 4 inches and smaller shall be wrench or lever operated. Valves installed 6 feet or less above the finished floor shall be provided complete with a removable wrench; valves installed more than 6 feet above the finished floor shall be provided complete with a chain operated lever and chain for easy operation from floor level.
   3. All lubricated plug valves 6 inches and larger shall be worm gear operated and shall be provided with a spoked type handwheel. Valves installed more than 6 feet above the finished floor shall be additionally provided with a chain wheel and chain for easy operation from floor level.

D. VALVE TYPE LP-1 (150 PSIG, Screwed)
   1. Valves shall be of the two-port, straight through type with semi-steel body, coated plug, and screwed ends.
   2. Valves shall have a WOG pressure rating of not less than 150 psig.
   3. Valves shall be UL listed for gas service.
   4. Valves shall be Homestead Figure 601, or as approved.

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A. ACCEPTABLE MANUFACTURERS

1. Nibco Incorporated.
2. ITT Grinnell.

B. GENERAL

1. All check valves shall have renewable trim.
2. All valves shall be “Industrial Duty” unless otherwise specified.

C. VALVE TYPE C-1 (125 PSIG, Screwed)

1. Valves shall be of the swing type with bronze body, screwed cap, and teflon disc.
2. Valves shall have a SWP pressure rating of not less than 125 psig and a WOG pressure rating of not less than 200 psig.
3. Solder end valves shall be Nibco Model S-413-Y, or as approved; screwed end valves shall be Nibco Model T-413-Y, or as approved.

D. VALVE TYPE C-2 (300 PSIG, Screwed)

1. Valves shall be of the swing type with bronze body, screwed cap, teflon disc, and screwed ends.
2. Valves shall have a SWP pressure rating of not less than 300 psig.
3. Valves shall be Nibco Model T-473-Y, or as approved.

E. VALVE TYPE C-3 (250 PSIG, Screwed, Non-slam)

1. Valves shall be of the silent guided spring type with bronze body, stainless steel spring, teflon seat ring, and teflon disc.
2. Valves shall have a WOG pressure rating of not less than 250 psig.
3. Solder end valves shall be Nibco Model S-480-Y, or as approved; screwed end valves shall be Nibco Model T-480-Y, or as approved.

F. VALVE TYPE C-4 (125 PSIG, Flanged)

1. Valves shall be of the swing type with iron body, flanged ends, bolted cap, bronze seat, and bronze disc.
2. Valves shall have a SWP pressure rating of not less than 125 psig and a WOG pressure rating of not less than 200 psig.
3. Valves shall be Nibco Model F-918-B, or as approved.

G. VALVE TYPE C-5 (250 PSIG, Flanged)

1. Valves shall be of the swing type with iron body, flanged ends, bolted cap, bronze seat, and bronze disc.
2. Valves shall have a SWP pressure rating of not less than 250 psig.
3. Valves shall be Nibco Model F-968-B, or as approved.
H. VALVE TYPE C-6 (125 PSIG, Flanged, Non-slam)
   1. Valves shall be of the globe pattern, silent guided spring type, flanged end or wafer style, with iron body, stainless steel spring, bronze seat, and bronze disc.
   2. Valves shall have a WOG pressure rating of not less than 125 psig.
   3. Valves shall be Nibco Model F-910-B or Nibco Model W-910-B, as applicable, or as approved.

I. VALVE TYPE C-7 (200 PSIG, Fire Sprinkler Systems)
   1. Valves shall be of the spring loaded butterfly type with cast iron body, stainless steel shafts, ductile iron disc, stainless steel spring, and Buna-N seats.
   2. Valves shall be FM approved.
   3. Valves shall have a WOG pressure rating of not less than 200 psig.
   4. Valves shall be Mueller Model 71, or as approved.

J. VALVE TYPE C-8 (600 PSIG, Flanged)
   1. Valves shall be of the swing type with cast steel body, raised face flanged ends, bolted seat, steel seat, and steel disc.
   2. Valve shall have a SWP pressure rating of not less than 600 psig and a maximum operating temperature of 850° F, and a WOG pressure rating of not less than 1480 psig and a maximum operation temperature of 100° F.
   3. Valves shall be Nibco Model No. CS-672-U, or as approved.

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A. ACCEPTABLE MANUFACTURERS

1. Nibco Incorporated.
2. Watts Regulator Company.
3. Or as approved.

B. VALVE TYPE SD-1

1. Valves shall be of the angle type with bronze body, screwed bonnet, rising stem, replaceable disc, 3/4 inch hose thread outlet, and aluminum alloy handwheel.
2. Valves shall have a WOG pressure rating of not less than 125 psig.
3. Solder inlet valves shall be Nibco Model 72, or as approved; screwed inlet valves shall be Nibco Model 73, or as approved.

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SECTION 15112

BALANCING FITTINGS

A. ACCEPTABLE MANUFACTURERS

1. Hoffman ITT.


3. Or as approved.

B. BALANCING FITTINGS

1. Balancing fittings shall be of brass construction, shall be suitable for working pressures of not less than 125 psig, and shall have ends suitable for the associated piping system.

2. Balancing fittings shall be designed to modulate from full open to full closed with one quarter turn of the valve stem. Fitting shall be operable with coin or screwdriver. Slot in stem shall align with piping centerline when the fitting is wide open.

3. Balancing fittings shall be Hoffman No. 199-B or 199-BT, as applicable, or as approved.

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SECTION 15113
BACKFLOW PREVENTERS

A. ACCEPTABLE MANUFACTURERS
   1. Watts Regulator Company.
   2. Febco.

B. MAIN-LINE BACKFLOW PREVENTERS
   1. Backflow preventers shall be of the reduced pressure principal type.
   2. Backflow preventers shall consist of an atmospheric discharge differential pressure relief valve mounted between two spring-loaded check valves, strainer, and shutoff valves with test port on upstream valve. Check valve seats shall be of the resilient type and all internal parts of the device shall be of corrosion-resistant construction.
   3. Units shall be provided with test cocks on both sides of both check valves.
   4. Units 2-1/2 inch size and larger shall have epoxy lined cast iron bodies, gate valves, and flanged ends; units 2 inch size and smaller shall have bronze bodies, full port ball valves, and screwed ends.
   5. Units shall be completely serviceable without removal from the pipeline.
   6. Main-line backflow preventers shall be Watts No. 909-S.

C. HOSE BIBB BACKFLOW PREVENTERS
   1. Backflow preventers shall be of brass construction with a silicone disc primary check valve, rubber seat, atmospheric vent, and a "nonremovable" feature.
   2. Backflow preventers shall be Watts No. 8A.

D. PORTABLE TEST KITS
   1. Portable test kits shall consist of a differential pressure gauge, three hoses with suitable end connections and adaptors for connecting to valve test connections, bleed valves, test valves, operating instructions, and a carrying case.
   2. Differential pressure gauge shall be accurate within three percent of the full scale reading, and shall be inherently protected against over-range readings.
   3. Meters shall have provisions for hanging to facilitate use and shall be suitable for working pressures of not less than 125 psig.
   4. Portable test kits shall be Watts Regulator Model TK-9A.

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FLEXIBLE CONNECTORS AND PUMP CONNECTORS

A. ACCEPTABLE MANUFACTURERS
   
   2. Flexonics Division, Universal Oil Products Company.
   3. Anaconda Metal Hose Division, Anaconda American Brass Company.
   4. The Metraflex Company.
   5. Or as approved.

B. FLEXIBLE CONNECTORS
   
   1. Flexible connectors shall be of the metallic braid covered corrugated tube type with pipe ends. Tube and braid shall be of the same material - bronze through 2 inch pipe sizes and stainless steel for pipe sizes 2-1/2 inches and larger. Connectors shall have a working pressure rating of not less than 150 psig (minimum).
   2. Connectors in copper lines shall have sweat connections and shall be Keflex Type KFCB-CTF, or as approved.
   3. Connectors in steel lines 2 inches and smaller shall have threaded ends and shall be Keflex Type KFCB-MPT, or as approved.
   4. Connectors in steel lines 2-1/2 inches and larger shall have flanged ends and shall be Keflex Type KFCS-FLG, or as approved.
   5. Connector end piece materials shall be fully compatible with the piping system in which the connector is installed.

C. PUMP CONNECTORS
   
   1. Pump connectors shall be of the uncovered corrugated tube type with flange ends and tie rods. Tube shall be of laminated multi-ply stainless steel construction. Connectors shall have a working pressure of not less than 150 psig.
   2. Pump connectors shall be Keflex Type 150-TR-2115, or as approved.

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SECTION 15123

PIPELINE STRAINERS

A. ACCEPTABLE MANUFACTURERS
   1. Mueller Steam Specialty.
   2. Hoffman Specialty ITT.
   3. Or as approved.

B. STRAINER TYPE ST-1
   1. Strainers shall be of the Y-type with cast bronze body, screwed cleanout cap complete with tapped blowdown connection, and stainless steel or monel strainer screen (20-mesh).
   2. Strainers shall have a SWP pressure rating of not less than 150 psig.
   3. Solder end strainers shall be Mueller No. 353-1/2M, or as approved; screwed end strainers shall be Mueller No. 351M, or as approved.

C. STRAINER TYPE ST-2
   1. Strainers shall be of the Y-type with cast bronze body, screwed ends, screwed cleanout cap complete with tapped blowdown connection, and stainless steel or monel strainer screen (20-mesh).
   2. Strainers shall have a SWP pressure rating of not less than 300 psig.
   3. Strainers shall be Mueller No. 352M, or as approved.

D. STRAINER TYPE ST-3
   1. Strainers shall be of the Y-type with cast bronze body, flanged ends, flanged cleanout cap complete with tapped blowdown connection, and stainless steel or monel strainer screen (20-mesh).
   2. Strainers shall have a SWP pressure rating of not less than 150 psig.
   3. Strainers shall be Mueller No. 851, or as approved.

E. STRAINER TYPE ST-4
   1. Strainers shall be of the Y-type with iron body, flanged ends, flanged cleanout cap complete with tapped blowdown connection, and stainless steel or monel strainer screen (0.045 inch perforations).
   2. Strainers shall have a SWP pressure rating of not less than 125 psig.
   3. Strainers shall be Mueller No. 751, or as approved.

F. STRAINER TYPE ST-5
   1. Strainers shall be of the Y-type with cast carbon steel, screwed ends, screwed cleanout cap complete with tapped blowdown connection, and stainless steel strainer screen (20 mesh).
   2. Strainers shall have a SWP pressure rating of not less than 600 psig, and maximum operating temperature of 838° F.
   3. Strainers shall be Mueller No. 861, or as approved.

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SECTION 15124

AIR VENTS

A. ACCEPTABLE MANUFACTURERS

1. Hoffman Specialty ITT.
2. Bell and Gossett ITT.
4. Or as approved.

B. MANUAL AIR VENTS

1. Manual air vents shall be of the screwdriver-operated type with nickel plated body, 1/8 inch threaded pipe inlet, and tubing sized discharge.
2. Manual air vents shall have a WOG pressure rating of not less than 150 psig.
3. Manual air vents shall be Bell and Gossett Model 4V, or as approved.

C. AUTOMATIC AIR VENTS

1. Automatic air vents shall be of the float operated type with cast brass body, screwed inlet, built-in check valve, and a discharge suitable for a 1/8 inch threaded pipe connection.
2. Automatic air vents shall have a WOG pressure rating of not less than 150 psig.
3. Automatic air vents shall be Hoffman No. 78, or as approved.

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DIVISION 15 - 74 SECTION 15130
GAUGES AND THERMOMETERS

A. ACCEPTABLE MANUFACTURERS
1. H. O. Trerice Company.
2. Albert A. Weiss and Son, Inc.
3. Tel-Tru Company.
4. Or as approved.

B. PRESSURE GAUGES AND COMPOUND GAUGES
1. Gauges shall be of the bourden type with black embossed letters and black pointer against a white face. Gauges shall utilize bushed phosphor bronze bearings, shall have a 1/4 inch NPT inlet, and shall have a dial not less than 3-1/2 inches in diameter.
2. Gauges shall be Trerice No. 600 Series or No. 660 Series, as applicable, or as approved.

C. DIAL THERMOMETERS
1. Dial thermometers shall be of the Bimetal dial type with white finished aluminum face with black and blue markings and black balanced aluminum pointer. Case and ring shall be Type 300 Series stainless steel; case shall be hermetically sealed; and be of the adjustable angle type. Stem shall have a 1/4 inch NPT inlet.
2. Dial faces shall be either 3 inches or 5 inches in diameter, as required for maximum readability.
3. Thermometers shall be Trerice No. B836 or B856, as applicable, or as approved.

D. REMOTE DIAL THERMOMETERS
1. Remote thermometers shall be of the non-mercury, vapor or liquid actuated, dial type with white finished aluminum face with black and blue markings and black balanced aluminum pointer. Case and ring shall be Type 300 Series stainless steel; case shall be hermetically sealed; and be of the adjustable angle type. Stem shall have a 1/4 inch NPT inlet.
2. Dial faces shall be either 3-1/2 inches in diameter, flush mounted type for panel mounted units and surface mounted for all other applications.
3. Thermometers shall be Trerice Series No. 80000, or as approved.

E. DIAL THERMOMETER THERMOWELLS
1. Thermowells shall be of the separable type, specifically sized for the accompanying thermometer.
2. Thermowells for use in insulated piping or insulated equipment shall be of the extended neck type.
3. Thermowells for use in other than stainless steel and plastic piping and equipment shall be of brass construction. Sockets shall be Trerice 7-3D Series, as applicable, or as approved.
4. Thermowells for use in stainless steel and plastic piping and equipment shall be of stainless steel construction; stainless steel shall be of a type compatible with the piping or equipment. Sockets shall be Trerice 7-3G Series, as applicable, or as approved.
DIVISION 15 - 76
SECTION 15151

FLUID FLOW-MEASURING SYSTEMS

A. ACCEPTABLE MANUFACTURERS

1. Bell & Gossett ITT.
3. Or as approved.

B. GENERAL

1. The flow-measuring system shall consist of a matched assortment of balancing-type flow-measuring orifices, regular-type flow-measuring orifices, and portable readout meters.

C. BALANCING-TYPE FLOW-MEASURING ORIFICES

1. Balancing-type flow-measuring orifices shall consist of a calibrated, bronze body balance valve, with provisions for connecting a differential pressure meter across the valve. Meter connections shall have built-in check valves or integral stop valves and shall be provided with thread protectors. Balance valve shall be of the ball or globe type, shall be suitable for use as a shut-off valve, shall have screwed ends, shall have an integral drain provision, and shall be suitable for a working pressure of not less than 125 psig. Valve shall be provided with an easily readable scale for determining the degree of valve opening and an adjustable memory feature to allow reopening of the valve to the preset balance position after use as a shut-off.
2. Balancing-type flow-measuring orifices shall be Bell & Gossett Circuit Setter Plus, or as approved.

D. REGULAR-TYPE FLOW-MEASURING ORIFICES

1. Regular-type flow-measuring orifices shall consist of a calibrated orifice with provisions for connecting a differential pressure meter across the orifice opening. Meter connections shall have built-in check valves or integral stop valves and shall be provided with thread protectors. Orifice shall be suitable for working pressures of not less than 125 psig, shall be designed to be inserted between standard pipe flanges or welded directly into the piping system, and shall be provided with an attached capacity curve nameplate.
2. Regular-type flow-measuring orifices shall be Bell & Gossett Circuit Sensor, or as approved.

E. PORTABLE READOUT METERS

1. Portable readout meters shall consist of a differential pressure gauge, two hoses with suitable end connections for connecting to orifice meter connections, bleed valves, shut-off valves, operating instructions, and a carrying case.
2. Differential pressure gauge shall have a reading range from 0.5 feet to 25 feet of water, shall be accurate within three percent of the full scale reading, and shall be inherently protected against over-range readings.
3. Meters shall have provisions for hanging to facilitate use and shall be suitable for working pressures of not less than 125 psig.
4. Portable readout meters shall be Bell & Gossett Model RO-5, or as approved.

* * * * *
A. ACCEPTABLE MANUFACTURERS

1. Motors
   a. GE.
   b. Westinghouse Electric Company.
   e. Reliance Electric Company.
   f. Or as approved.

2. Motor Starters (No Substitutions)

B. MOTORS

1. Motors shall be of the totally enclosed fan cooled (TEFC) type unless specifically noted otherwise in the technical section for the equipment served or unless prohibited by an applicable code.

2. All single-phase motors shall have built-in thermal overload protection.

3. Motors for use with part winding or wye-delta, reduced voltage motor starters shall be supplied with the proper number and arrangement of motor leads for the intended service.

4. Motors for use with variable frequency controllers shall be inverter rated.

5. Motors shall be of the high efficiency type, conforming to the following table as a minimum (for 1800 rpm motors):

<table>
<thead>
<tr>
<th>Horsepower</th>
<th>Minimum Efficiency (%)</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>88.1</td>
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<tr>
<td>5</td>
<td>88.1</td>
</tr>
<tr>
<td>7.5</td>
<td>89.8</td>
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<tr>
<td>10</td>
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<tr>
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<tr>
<td>75</td>
<td>95.0</td>
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<tr>
<td>100</td>
<td>95.0</td>
</tr>
</tbody>
</table>

C. MOTOR STARTERS

1. Units shall be of proper size for the load being controlled, shall be rated for the available fault current, and shall be supplied with all accessories (such as auxiliary contacts) required to provide the sequences of operation specified.

2. Motor starters shall be of the full voltage, nonreversing type, unless specifically noted otherwise.

3. Reduced voltage type shall be of the closed transition type and shall be equipped with all necessary timers for proper sequence and timing of operation. Reduced voltage starters shall be of the auto-transformer type.
4. Control circuits shall be of a voltage compatible with the specified control devices but shall, in no case, exceed 120 volts. Appropriate control transformers shall be supplied as an integral part of the motor starter for all cases where the control circuit voltage is lower than the motor voltage. Control transformers shall be supplied with grounded and fused secondaries.

5. Motor starters and motor controls in factory-packaged equipment shall be of a type whereby a motor operating at the time of power interruption will resume operation upon restoration of power, without the need for manual reset. Motor starters shall be supplied with hand-off-auto switches and pilot lights in the cover.

6. Starters for all electrical loads greater than 5 HP or equivalent and for all loads where one device is interlocked with a similar device in automatic standby mode shall be provided with integral time delay relays. Relays shall be of the instant off, delayed on type with delay time adjustable from zero to 120 seconds.

7. All motor starters shall be complete with "properly sized" overload protection (in each ungrounded line) with manual reset.

8. Disconnect handles on combination starters shall be lockable.

9. See Division 1600.

D. DISCONNECTS

1. Units shall be of proper size for the load being controlled. See Division 1600.

E. FACTORY-WIRED PACKAGED EQUIPMENT

1. Every piece of factory-wired equipment specified to be suitable for single point external power connection shall be provided complete with all necessary motor circuit and/or overload protection devices.

2. Motor circuit and/or overload protection devices in such equipment shall be of the fuse type.

3. The equipment shall not require external fuse protection of any sort in order to maintain its Underwriters Laboratories Inc. listing.

* * * * *
DIVISION 15 - 79

SECTION 15190

IDENTIFICATION SYSTEMS

A. ACCEPTABLE MANUFACTURERS

1. Seton Name Plate Corporation.
2. W.H. Brady Company.
3. Or as approved.

B. EQUIPMENT LABELS

1. Labels shall be engraved laminated plastic with a dark colored face and white lettering. Labels shall be not less than 1/16 inch thick.
2. Label lettering shall identify the equipment by name and number in agreement with the Contract Documents (for example, "EXHAUST FAN EF-1").
3. Labels shall be engraved Setonite Name Plates, or as approved.

C. PIPING AND DUCTWORK LABELS

1. Labels shall be adhesive-backed vinyl cloth with contrasting (generally black) letters.
2. Small labels shall be not less than 3/4 inch wide. Large labels shall be not less than 2 inches wide.
3. Label lettering shall identify both the medium being conveyed, the pipe and duct size, and the direction of flow.
4. Pressure-sensitive tape shall be unprinted, solid color, adhesive-backed vinyl. Tape shall be 3/4 inch wide, minimum.
5. Labels shall be Brady Pipe Markers, or as approved.

D. VALVE TAGS AND CHARTS

1. Valve tags shall be 1-1/2 inches in diameter, 18 gauge brass or copper, complete with short brass attachment chain. Tags shall be stamped or engraved with an appropriate alphanumeric code (prefix with the letter(s) "H," "P," or "FP," as appropriate).
2. Valve charts shall be typewritten on white bond paper and shall be mounted in glass front frames. Valve charts shall be mounted in the building's main Mechanical Room.
3. Valve charts shall show the location and function of every tagged valve.

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DIVISION 15 - 80  SECTION 15203

CHEMICAL TREATMENT FOR CLOSED HYDRONIC SYSTEMS

A. ACCEPTABLE MANUFACTURER (No Substitutions)
   1. Nalco Chemical Company.

B. CHEMICALS
   1. All chemicals shall be compatible with the piping systems and equipment.
   2. All chemicals shall be delivered to the Owner in unopened, clearly marked containers.
   3. Chemical containers shall be of an easily manageable size.

C. ONE-SHOT FEEDERS
   1. Feeders shall be of cast iron or steel construction suitable for 125 psig working pressure.
   2. Feeders shall have provisions for fill, drain, and circulation piping.
   3. Feeders shall be of adequate capacity to accept normal addition of system chemicals in one application.
   4. Large feeders shall be of the floor-mounted type and shall be complete with appropriate supports.

* * * * *
SECTION 15204

CHEMICAL TREATMENT FOR OPEN HYDRONIC SYSTEMS

A. ACCEPTABLE MANUFACTURER (No Substitutions)
   1. Nalco Chemical Company

B. CHEMICALS
   1. All chemicals shall be compatible with the piping systems and equipment.
   2. All chemicals shall be delivered to the Owner in unopened, clearly marked containers.
   3. Chemical containers shall be of an easily manageable size.

C. CONTROL PANEL
   1. Control panel shall be of NEMA 1 construction; shall have a lockable, hinged viewing window; shall include a 3-wire power cord; shall include duplex receptacles for chemical feed pumps; shall house all electronic components necessary to achieve the specified program; and shall include a remote flow switch and remote conductivity-sensing electrode.
   2. Control panel shall include a conductivity dial, a biocide timer, an inhibitor feed timer with test switch, and all necessary pilot lights for complete monitoring of the system operation.

D. WATER METER
   1. Make-up water meter shall be of the contacting head type suitable for a 12 volt control signal.

E. SOLUTION TANKS
   1. Solution tanks shall be of polyethylene or stainless steel construction and shall include a hinged cover, a suction connection, and a drain connection.
   2. Solution tanks shall be of adequate size to hold not less than a one month supply of the associated treatment chemical.

F. FEED PUMPS
   1. Feed pumps shall be of the positive displacement type with adjustable stroking mechanism and a minimum 160 feet discharge head.
   2. Feed pumps shall be suitable for 115 volt operation and shall be complete with a cord and plug compatible with the control panel.

* * * * *
SECTION 15240
VIBRATION ISOLATION

A. ACCEPTABLE MANUFACTURERS

1. Mason Industries.
2. Korfund Dynamics Corporation.
4. Peabody Noise Control.
5. Or as approved.

B. GENERAL

1. All isolators provided under the Work of any one mechanical trade shall be supplied by a single manufacturer.
2. Isolators shall be stable during starting and stopping of equipment without any traverse and eccentric movement of equipment that would damage or adversely effect the equipment or attachments.
3. All exposed steel surfaces of isolators shall be provided with a factory prime finish suitable for a field application of final enamel finish.
4. All springs for isolators to be used in outdoor applications or in high humidity indoor applications shall be neoprene coated.

C. RESILIENT ISOLATORS

1. Isolators shall utilize elastomer, rubber, or neoprene in compression or shear as the isolating medium.
2. Units shall be reinforced with steel at all bearing surfaces and threaded openings. Steel parts shall be imbedded in the isolating medium.
3. Units for floor mounting shall utilize a base plate and a threaded top plate. Units shall be Mason Industries Model ND, or as approved.
4. Units for use in hanger rods shall utilize a base plate and a top plate. Unit shall be bored from top to bottom and shall be enclosed in a heavy steel housing with bolt holes on the top and bottom. Units shall be Mason Industries Model HD, or as approved.

D. SPRING ISOLATORS

1. Spring isolators shall be free-standing and laterally stable without any housing and shall be complete with 1/4 inch neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80 percent of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.
2. Spring isolators shall be Mason Industries Model SLF, or as approved.

E. SPRING ISOLATORS WITH VERTICAL STOPS

1. Units shall be provided with a housing that includes vertical resilient limit stops to prevent spring extension when weight is removed. Units shall be provided with a 1/4 inch neoprene acoustical friction pad between the baseplate and the support and with leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 80 percent of the compressed height of the
spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of
the rated deflection.

2. Units shall be Mason Industries Model SLR, or as approved.

F. RAIL TYPE ISOLATORS

1. Rail type isolators shall consist of resilient isolators bolted to structural steel channels to provide
   supplementary stiffening between equipment mounting locations. Rail type isolators shall be sized
   specifically for the equipment being supported.

2. Rail type isolators for base-mounted end suction pumps shall be complete with cross members,
   including one properly positioned to support the suction diffuser support leg.

3. Rail type isolators shall be Mason Industries Type DNR, or as approved.

G. STRUCTURAL STEEL BASES

1. Bases shall consist of structural steel members welded to form a rigid chassis. Bases shall be sized
   specifically for the equipment being supported. Height-saving brackets shall be employed to provide
   a base-to-floor clearance of not less than 1 inch.

2. Support brackets shall be designed to accommodate an appropriate spring isolator.

3. Structural steel bases shall be Mason Industries Type WF, or as approved.

H. INERTIA BASES

1. Inertia bases shall consist of a prefabricated structural steel concrete form complete with concrete
   reinforcement and concrete. Bases shall be sized specifically for the equipment being supported.

2. Inertia base depths shall be a minimum of 1/12 of the longest dimension but not less than 6 inches nor
   more than 12 inches unless dictated otherwise by weight requirements.

3. Inertia bases shall be provided with steel members to hold anchor bolt sleeves when the anchor bolts
   fall in concrete locations.

4. Height-saving brackets shall be employed to maintain a 1 inch minimum clearance between the
   bottom of the inertia base and the floor.

5. Support brackets shall be designed to accommodate an appropriate spring isolator.

6. Inertia bases shall be Mason Industries Type K, or as approved.

* * * * *
A. ACCEPTABLE MANUFACTURERS

1. Insulation
   b. Owens-Corning Fiberglas Corporation.
   c. Armstrong World Industries, Inc.
   d. Certainteed.
   e. Or as approved.

2. Fitting Jackets
   b. Insultech.
   c. Or as approved.

3. Adhesives, Mastics, and Coatings
   a. Foster Products, H.B. Fuller Company.
   b. Armstrong World Industries, Inc.
   c. Or as approved.

B. QUALITY ASSURANCE

1. The following publications are referenced in this section and are listed here by organization, basic designation, title, and year of issue. The publications are listed throughout the remainder of the section by basic designation only.
      1) ASTM C 165; Standard Recommended Practice for Measuring Compressive Properties of Thermal Insulations; 1983.
      6) ASTM C 585; Standard Recommended Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System); 1976.
C. GENERAL

1. Insulation systems shall be complete in every respect and shall include all necessary accessories such as vapor barriers, adhesives, compounds, joint sealers, covering, and reinforcing tape.

2. All insulation and accessories, unless otherwise specified herein, shall have component fire hazard classification not to exceed the Flame Spread and Smoke Developed ratings, identified in the most recent version of the International Mechanical Code, when tested in accordance with ASTM E 84.

3. Adhesives, sealers, and vapor barrier coatings shall be compatible with the materials to which they are applied and shall not soften, corrode, or otherwise attack said materials whether dry or wet.

4. Each insulation and accessory component shall bear the manufacturer's label of description.

5. Premolded insulations shall meet all dimensional requirements of ASTM C 585.

D. FIBROUS GLASS PIPE INSULATION

1. DENSITY, 3 (lbs.)/(cu.ft.), minimum.

2. THERMAL CONDUCTIVITY, 0.26 (BTU)(inch)/(hour)(degree F)(sq.ft.), maximum, at 75 degrees F, when tested in accordance with ASTM C 177, ASTM C 335, or ASTM C 518.

3. MOISTURE ABSORPTION, 1.0 percent by volume, maximum, after 96 hours at 120 degrees F and 95 percent relative humidity.

4. CAPILLARITY, negligible after 24 hours.

5. THERMAL STABILITY, negligible shrinkage when tested in accordance with ASTM C 356.

E. FIBROUS FOAMED PLASTIC PIPE INSULATION

1. DENSITY, 4.5 to 8.5 (lbs.)/(cu.ft.), minimum, when tested in accordance with ASTM C 518.

2. THERMAL CONDUCTIVITY, 0.28 (BTU)(inch)/(hour)(degree F)(sq.ft.), maximum, at 75 degrees F, when tested in accordance with ASTM C 177, ASTM C 335, or ASTM C 518.

3. WATER VAPOR TRANSMISSION, 0.1 (perm)(inch), maximum, when tested in accordance with ASTM E 96 (wet cup).

4. THERMAL STABILITY, 7 percent shrinkage, maximum, during seven days at 200 degrees F, when tested in accordance with ASTM C 356.

F. CALCIUM SILICATE PIPE INSULATION

1. DENSITY, 12 (lbs.)/(cu.ft.), minimum.

2. THERMAL CONDUCTIVITY, 0.40 (BTU)(inch)/(hour)(degree F)(sq.ft.), maximum, at 200 degrees F, when tested in accordance with ASTM C 177, ASTM C 335, or ASTM C 518.

3. COMPRESSIVE STRENGTH, 200 (lbs.)/(sq.in.), minimum, at 5 percent deformation, when tested in conformance with ASTM C 165.

4. THERMAL STABILITY, 1.5 percent shrinkage, maximum, during 24 hours at 1,200 degrees F, when tested in conformance with ASTM C 356.

G. FABRICS AND JACKET MATERIALS

1. CLASS 1 JACKETS shall be heavy-duty, white-faced, scrim reinforced kraft paper bonded to a heavy-duty aluminum foil vapor barrier. Jacket shall have a puncture resistance of 50 beach units, minimum, and shall have a water vapor permeance of 0.02 perm, maximum, when tested in accordance with ASTM E 96.
2. CANVAS JACKETS shall be of the best quality canvas. Jacket for use on fittings and valves (2 inch size and smaller) shall be 4 (oz.)/(sq.yd.), minimum; all other jacket material shall be 6 (oz.)/(sq.yd.), minimum.

3. GLASS CLOTH shall be open weave, white, fibrous glass fabric with a mastic coating for dimensional stability. Fabric shall have a thread count of 10 yarns per inch in both directions and a total weight of approximately 1.9 (oz.)/(sq.yd.).

4. METAL JACKETS shall be 0.016 inch thick (minimum), Type 3003 or 3005 aluminum secured in place with 0.010 inch thick (minimum) stainless steel bands and complete with 2 inch wide, 0.016 inch thick aluminum bands (lined with a permanent plastic seal) at all circumferential joints.

5. PREMOLDED POLYVINYL CHLORIDE FITTING JACKETS shall be the continuous one piece, high impact type with a puncture resistance of 200 beach units (minimum).

H. THERMAL BLANKET INSULATION (Systems to 450 degrees F)

1. OUTER JACKET, 17.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

2. INSULATION, Fiberglass Needled Mat - Type “E” Fiber - 11 lb./ft.\(^3\) density.

3. INNER JACKET, 17.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

4. Thermal blanket insulation shall be Insultech LT450SS, or as approved.

I. THERMAL BLANKET INSULATION (Systems 800 degrees F to 1200 degrees F)

1. OUTER JACKET, 17.7 oz./sq. yd. Plain Fiberglass Cloth and Stainless Steel Type 304 Knitted Wire Mesh .011” Dia. @ 16 sf./lb.

2. INSULATION, Fiberglass Needled Mat - 11 lb./ft.\(^3\) density.

3. INNER JACKET, Stainless Steel Type 304 Knitted Wire Mesh .011” Dia. @ 16 sf./lb. and 17.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

4. Thermal blanket insulation shall be Insultech HT1100MSGM, or as approved.

J. THERMAL BLANKET INSULATION (Systems 450 degrees F to 800 degrees F)

1. OUTER JACKET, 34.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

2. INSULATION, Fiberglass Needled Mat - 11 lb./ft.\(^3\) density.

3. INNER JACKET, Stainless Steel Type 304 Knitted Wire Mesh .011” Dia. @ 16 sf./lb., and 17.7 oz./sq. yd. Plain Fiberglass Cloth.

4. Thermal blanket insulation shall be Insultech MT800SGM, or as approved.

K. THERMAL BLANKET INSULATION (Acoustic Insulation)

1. OUTER JACKET, 16.5 oz./sq. yd. PTFE Teflon Impregnated Fiberglass Cloth.

2. ACOUSTIC BARRIER, Barium Sulfate Loaded Vinyl (0.5 to 1.5 lb density).

3. INSULATION, Fiberglass Needled Mat - 11 lb./ft.\(^3\) density.

4. INNER JACKET, 16.5 oz./sq. yd. PTFE Teflon Impregnated Fiberglass Cloth.
5. Thermal blanket insulation shall be Insultech LT450A-TT, or as approved.

L. THERMAL BLANKET INSULATION (Manholes and Confined Spaces)

1. OUTER JACKET, 20.0 oz./sq. yd. PTFE Teflon Film Laminated, Impregnated Nomex Woven Cloth.

2. INSULATION, Fiberglass Needled Mat - 8 lb./ft. $^3$ density.

3. INNER JACKET, 20.0 oz./sq. yd. PTFE Teflon Film Laminated, Impregnated Nomex Woven Cloth.

4. Thermal blanket insulation shall be Insultech LT450STF20, or as approved.

M. THERMAL BLANKET STANDARD FASTENERS

1. FASTENER, 20 gauge stainless steel wire, length is 16” minimum. Secure to lacing pin at the pin stem. Lacing pin shall be 14 gauge.

2. FASTENER, the blanket fastener shall be 2” polypropylene side release buckles with 1.75” wide fabric straps. The buckle strap shall be 7” minimum in length and stitched to the outer jacket surface. The pull strap shall be sewn on the outer jacket surface and match up to the buckle strap. Minimum length is 16”.

3. LACING PINS, Stainless steel Type 304. 12 or 14 gauge.

4. RING STRAP WITH HOOK & LOOP TAB, double sewn three layer fabric strap. Pulldown strap is 16” long and the other stationary strap is 6” long. Both straps are stitched to the outer jacketing of the blanket. The stationary strap includes a Stainless Steel Type 304 “D” ring.

5. HOOK & LOOP FLAPS, Hook & loop fastener are sewn to outer jacketing flap. Hook & Loop flaps consist of a 2” wide hook stitched to the blanket and a 2” wide loop stitched to the outer jacketing flap.

6. HOOK & LOOP, Hook & loop fastener are sewn to outer jacketing flap. A 1” wide “D” ring fastener is sewn onto the belt. A 3” minimum belting will be secured to the outer jacketing of the blanket.

N. WIRING, BINDING, AND FASTENING DEVICES

1. WIRE for binding or lacing, unless otherwise specified, shall be No. 16 gauge (minimum) copper clad or galvanized, annealed steel wire.

O. ADHESIVES AND CEMENTS

1. LAP ADHESIVE FOR CLASS 1 JACKETS shall be Foster 85-75, or as approved.

2. INSULATING CEMENT shall be of the hard setting type.

3. VAPOR BARRIER MASTIC shall be Foster 30-35, or as approved.

4. ADHESIVE FOR FLEXIBLE FOAMED PLASTIC shall be Armstrong 520, Foster 82-31, or as approved.

5. BEDDING ADHESIVE FOR CALCIUM SILICATE INSULATION shall be Foster 81-27, or as approved.

6. LAGGING ADHESIVE FOR CANVAS JACKETS shall be Foster 81-42W, or as approved.
P. SEALING TAPES

1. **JACKETED INSULATION SEALING TAPE** shall be the pressure sensitive type of the same material as the associated insulation jacket.

Q. THERMAL INSULATION APPLICATION

1. Thermally insulate the entire piping systems, including all valves and fittings, except as specified below.

2. Domestic cold water systems thermal insulation system shall be fibrous glass, 1/2 inch thickness for all pipe sizes.

3. Domestic hot water system thermal insulation system shall be fibrous glass, 1 inch thickness for all piping sizes.

4. Above grade storm drainage systems from the roof drain to the next lower slab penetration shall be thermally insulated with fibrous glass insulation, 1/2 inch thickness for all pipe sizes, and 1 inch thickness for drain bodies.

5. Thermal insulation for HVAC cold water systems shall be fibrous glass of the following thickness:
   a. For piping up to 1-1/2 inch size, 1 inch thickness.
   b. For piping larger than 1-1.5 inch size, 1.5 inch thickness.

6. Heating hot water system thermal insulation shall be fibrous glass of the following thicknesses:
   a. For piping up to 3/4 inch size, 1 inch thickness.
   b. For piping 1 to 2 inch size, 1-1/2 inch thickness.
   c. For piping 2-1/2 inch to 6 inch size, 2 inch thickness.
   d. For piping larger than 6 inch size, 2-1/2 inch thickness.

7. Steam and condensate thermal insulation shall be fibrous glass of the following thicknesses:
   a. For piping up to 1 inch, 1-1/2 inches thick.
   b. For piping 1-1/4 inches to 4 inches, 2-1/2 inches thick.
   c. For piping larger than 4 inches, 3 inches thick.

8. The following components need not be insulated:
   a. Pressure reducing valves.
   b. Flow-measuring orifices.
   c. Relief valves.
   d. Relief valve discharge piping.
   e. Separable joints.
   f. Flexible connections.
   g. Drain valves.
   h. Balancing fittings.
   i. Strainer blow-down valves.
   j. Heating piping inside terminal unit enclosures.

* * * * *
A. ACCEPTABLE MANUFACTURERS

1. Insulation
   b. Owens-Corning Fiberglas Corporation.
   c. Armstrong World Industries, Inc.
   d. Certainteed.
   e. Or as approved.

2. Adhesives, Mastics, and Coatings
   a. Foster Products, H.B. Fuller Company.
   b. Armstrong World Industries, Inc.
   c. Or as approved.

3. Fitting Jackets
   a. Insultech.
   b. Or as approved.

B. GENERAL

1. Insulation systems shall be complete in every respect and shall include all necessary accessories such as vapor barriers, adhesives, compounds, joint sealers, covering, and reinforcing tape.

2. All insulation and accessories, unless otherwise specified herein, shall have component fire hazard classification not to exceed the Flame Spread and Smoke Developed ratings, identified in the most recent version of the International Mechanical Code, when tested in accordance with ASTM Specification E 84.

3. Adhesives, sealers, and mastics shall be compatible with the materials to which they are applied and shall not soften, corrode, or otherwise attack said materials whether dry or wet.

4. Each insulation and accessory component shall bear the manufacturer's label of description.

C. FIBROUS GLASS INSULATION

1. DENSITY
   a. Board (concealed), 3 (lbs.)/(cu. ft.), minimum.
   b. Board (exposed), 4.5 (lbs.)/(cu. ft.), minimum.

2. THERMAL CONDUCTIVITY, 0.26 (BTU)(inch)/(hour)(degree F)(sq.ft.), maximum, at 75 degrees F, when tested in accordance with ASTM C 177.

3. MOISTURE ABSORPTION, 0.2 percent by volume, maximum, after 96 hours at 120 degrees F and 95 percent relative humidity.

4. CAPILLARITY, negligible after 24 hours.

5. SHRINKAGE OR EXPANSION, fully cured to ensure negligible dimensional changes.

D. THERMAL BLANKET INSULATION (Systems to 450 degrees F)

1. OUTER JACKET, 17.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.
2. **INSULATION**, Fiberglass Needled Mat - Type “E” Fiber - 11 lb./ft.\(^3\) density.

3. **INNER JACKET**, 17.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

4. Thermal blanket insulation shall be Insultech LT450SS, or as approved.

**E. THERMAL BLANKET INSULATION** (Systems 800 degrees F to 1200 degrees F)

1. **OUTER JACKET**, Stainless Steel Type 304 Knitted Wire Mesh .011” Dia. @16 sf./lb. and 17.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

2. **INSULATION**, Fiberglass Needled Mat - 11 lb./ft.\(^3\) density.

3. **INNER JACKET**, 17.7 oz./sq. yd. Plain Fiberglass Cloth and Stainless Steel Type 304 Knitted Wire Mesh .011” Dia. @16 sf./lb.

4. Thermal blanket insulation shall be Insultech HT1100MSGM, or as approved.

**F. THERMAL BLANKET INSULATION** (Systems 450 degrees F to 800 degrees F)

1. **OUTER JACKET**, 34.0 oz./sq. yd. Silicone Impregnated Fiberglass Cloth.

2. **INSULATION**, Fiberglass Needled Mat - 11 lb./ft.\(^3\) density.

3. **INNER JACKET**, Stainless Steel Type 304 Knitted Wire Mesh .011” Dia. @16 sf./lb., and 17.7 oz./sq. yd. Plain Fiberglass Cloth.

4. Thermal blanket insulation shall be Insultech MT800SGM, or as approved.

**G. THERMAL BLANKET INSULATION** (Acoustic Insulation)

1. **OUTER JACKET**, 16.5 oz./sq. yd. PTFE Teflon Impregnated Fiberglass Cloth.

2. **ACOUSTIC BARRIER**, Barium Sulfate Loaded Vinyl (0.5 to 1.5 lb density).

3. **INSULATION**, Fiberglass Needled Mat - 11 lb./ft.\(^3\) density.

4. **INNER JACKET**, 16.5 oz./sq. yd. PTFE Teflon Impregnated Fiberglass Cloth.

5. Thermal blanket insulation shall be Insultech LT450A-TT, or as approved.

**H. THERMAL BLANKET INSULATION** (Manholes and Confined Spaces)

1. **OUTER JACKET**, 20.0 oz./sq. yd. PTFE Teflon Film Laminated, Impregnated Nomex Woven Cloth.

2. **INSULATION**, Fiberglass Needled Mat - 8 lb./ft.\(^3\) density.

3. **INNER JACKET**, 20.0 oz./sq. yd. PTFE Teflon Film Laminated, Impregnated Nomex Woven Cloth.

4. Thermal blanket insulation shall be Insultech LT450STF20, or as approved.

**I. THERMAL BLANKET STANDARD FASTENERS**

1. **FASTENER**, 20 gauge stainless steel wire, length is 16” minimum. Secure to lacing pin at the pin stem. Lacing pin shall be 14 gauge.
2. FASTENER, the blanket fastener shall be 2” polypropylene side release buckles with 1.75” wide fabric straps. The buckle strap shall be 7” minimum in length and stitched to the outer jacket surface. The pull strap shall be sewn on the outer jacket surface and match up to the buckle strap. Minimum length is 16”.

3. LACING PINS, stainless steel Type 304. 12 or 14 gauge.

4. RING STRAP WITH VELCRO TAB, double sewn three layer fabric strap. Pulldown strap is 16” long and the other stationary strap is 6” long. Both straps are stitched to the outer jacketing of the blanket. The stationary strap includes a stainless steel Type 304 “D” ring.

5. HOOK & LOOP FLAPS, Hook & loop fastener are sewn to outer jacketing flap. Hook & loop flaps consist of a 2” wide hook stitched to the blanket and a 2” wide loop stitched to the outer jacketing flap.

6. HOOK & LOOP, Hook & loop fastener are sewn to outer jacketing flap. A 1” wide “D” ring fastener is sewn onto the belt. A 3” minimum belting will be secured to the outer jacketing of the blanket.

J. WIRING, BINDING, AND FASTENING DEVICES

1. WIRE for binding or lacing, unless otherwise specified, shall be No. 16 gauge (minimum) copper clad or galvanized, annealed steel wire.

2. WIRE MESH shall be woven and galvanized No. 20 gauge steel wire with nominal one inch hexagonal openings. The wire mesh shall be galvanized after weaving.

3. DUCT INSULATION FASTENERS shall be of the weld (or epoxy) secured type. Fasteners shall include a nylon stop clip. Fasteners shall be as manufactured by Duropolyne, or as approved.

K. ADHESIVES AND CEMENTS

1. COLD WATERPROOF ADHESIVE shall be Foster Spark-Fas 85-20, or as approved.

2. GENERAL PURPOSE MASTIC shall be Foster Sealfas G-P-M 35-00, or as approved.

3. VAPOR BARRIER MASTIC shall be Foster Tite-Fit 30-35, or as approved.

4. INSULATING CEMENT shall be of the hard setting type.

L. FABRICS

1. REINFORCING MEMBRANE shall be Foster Mast-A-Fab, or as approved.

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A. ACCEPTABLE MANUFACTURERS

1. Insulation
   
   b. Owens-Corning Fiberglas Corporation.
   c. Armstrong World Industries, Inc.
   d. Certainteed.
   e. Or as approved.

2. Adhesives, Mastics, and Coatings
   
   a. Foster Products, H.B. Fuller Company.
   b. Armstrong World Industries, Inc.
   c. Or as approved.

B. QUALITY ASSURANCE

1. The following paragraphs list publications referenced in this section. The publications are listed here by organization, basic designation, title, and year of issue. The publications are listed throughout the remainder of the section by basic designation only.


      1) THE FOLLOWING REFERENCE IS APPLICABLE TO CALCIUM SILICATE INSULATION ONLY.

         a) ASTM C 165; Standard Recommended Practice for Measuring Compressive Properties of Thermal Insulations; 1983.

      2) THE FOLLOWING REFERENCES ARE APPLICABLE TO ALL INSULATION MATERIALS.


      3) THE FOLLOWING REFERENCE IS APPLICABLE TO ALL INSULATION MATERIALS AND ACCESSORIES.


      4) THE FOLLOWING REFERENCE IS APPLICABLE TO SOME JACKET MATERIALS.

C. GENERAL

1. Insulation systems shall be complete in every respect and shall include all necessary accessories such as vapor barriers, adhesives, compounds, joint sealers, covering, and reinforcing tape.

2. All insulation and accessories, unless otherwise specified herein, shall have component fire hazard classification not to exceed the Flame Spread and Smoke Developed 50 ratings, identified in the most recent version of the International Mechanical Code, when tested in accordance with ASTM E 84.

3. Adhesives, sealers, and vapor barrier coatings shall be compatible with the materials to which they are applied and shall not soften, corrode, or otherwise attack said materials whether dry or wet.

4. Each insulation and accessory component shall bear the manufacturer’s label of description.

D. FIBROUS GLASS BLANKET INSULATION

1. DENSITY, 1 (lb.)/(cu.ft.), minimum.

2. THERMAL CONDUCTIVITY, 0.28 (BTU)(inch)/(hour)(degree F) (sq.ft.), maximum, at 75 degrees F, when tested in accordance with ASTM C 177 or ASTM C 518.

3. MOISTURE ABSORPTION, 1.0 percent by volume, maximum, after 96 hours at 120 degrees F and 95 percent relative humidity.

4. CAPILLARITY, negligible after 24 hours.

5. THERMAL STABILITY, negligible shrinkage when tested in accordance with ASTM C 356.

E. FIBROUS GLASS BOARD INSULATION

1. DENSITY

   a. In boiler rooms, mechanical rooms, fan rooms, and similar mechanical spaces, 6 (lbs.)/(cu.ft.), minimum.

   b. For all other applications, 3 (lbs.)/(cu.ft.), minimum.

2. THERMAL CONDUCTIVITY, 0.23 (BTU)(inch)/(hour)(degree F)(sq.ft.), maximum, at 75 degrees F, when tested in accordance with ASTM C 177 or ASTM C 518.

3. MOISTURE ABSORPTION, 1.0 percent by volume, maximum, after 96 hours at 120 degrees F and 95 percent relative humidity.

4. CAPILLARITY, negligible after 24 hours.

5. THERMAL STABILITY, negligible shrinkage when tested in accordance with ASTM C 356.

F. CALCIUM SILICATE INSULATION

1. DENSITY, 12 (lbs.)/(cu.ft.), minimum.

2. THERMAL CONDUCTIVITY, 0.40 (BTU)(inch)/(hour)(degree F)(sq.ft.), maximum, at 200 degrees F, when tested in accordance with ASTM C 177 or ASTM C 518.

3. COMPRESSIVE STRENGTH, 200 (lbs.)/(sq.in.), minimum, at 5 percent deformation, when tested in conformance with ASTM C 165.

4. THERMAL STABILITY, 1.5 percent shrinkage, maximum, during 24 hours at 1,200 degrees F, when tested in conformance with ASTM C 356.
G. FABRICS AND JACKET MATERIALS

1. CLASS 1 JACKETS shall be heavy-duty, white-faced, scrim reinforced kraft paper bonded to a heavy-duty aluminum foil vapor barrier. Jacket shall have a puncture resistance of 50 beach units, minimum, and shall have a water vapor permeance of 0.02 perm, maximum, when tested in accordance with ASTM E 96.

2. CLASS 2 JACKETS shall be foil-faced with heavy-duty scrim reinforced aluminum foil bonded to heavy kraft paper backing. Jacket shall have a puncture resistance of 25 beach units, minimum, and shall have a water vapor permeance of 0.02 perm, maximum, when tested in accordance with ASTM E 96.

3. CANVAS JACKETS shall be of the best quality canvas. Jacket for use on fittings and valves, 2 inch size and smaller, shall be 4 (oz./sq.yd.), minimum; all other jacket material shall be 6 (oz./sq.yd.), minimum.

4. GLASS CLOTH shall be open weave, white, fibrous glass fabric with a mastic coating for dimensional stability. Fabric shall have a thread count of 10 yarns per inch in both directions and a total weight of approximately 1.9 (oz./sq.yd.).

H. WIRING, BINDING, AND FASTENING DEVICES

1. WIRE for binding or lacing unless otherwise specified shall be No. 16 gauge (minimum) copper clad or galvanized, annealed, steel wire.

2. DUCT INSULATION FASTENERS shall be of the weld, or epoxy, secured type. Fasteners shall include a nylon stop clip. Fasteners shall be as manufactured by Durodyne, or as approved.

3. WIRE MESH shall be woven and galvanized No. 20 gauge steel wire with nominal 1 inch hexagonal openings. The wire mesh shall be galvanized after weaving.

I. ADHESIVES AND CEMENTS

1. LAP ADHESIVE FOR CLASS 1 JACKETS AND CLASS 2 JACKETS shall be Foster 85-75, or as approved.

2. INSULATING CEMENT shall be of the hard setting type.

3. VAPOR BARRIER MASTIC shall be Foster 30-35, or as approved.

4. WEATHERPROOF MASTIC shall be Foster 60-35, or as approved.

5. BEDDING ADHESIVE FOR CALCIUM SILICATE INSULATION shall be Foster 81-27, or as approved.

6. LAGGING ADHESIVE FOR CANVAS JACKETS shall be Foster 81-42W, or as approved.

J. SEALING TAPES

1. JACKETED INSULATION SEALING TAPE shall be the pressure sensitive type of the same material as the associated insulation jacket.

K. THERMAL INSULATION APPLICATION

1. Concealed ductwork shall be insulated with blanket type insulation. Exposed ductwork shall be insulated with board type insulation.

2. Thermally insulate all plenums at roof and wall penetrations. Thermal insulation shall be fibrous glass, 1-1/2 inches thick.

3. Thermally insulate all outdoor air intake ductwork from the plenum to the air handling unit inlet connection. Thermal insulation shall be fibrous glass, 1-1/2 inches thick.
4. Thermally insulate all supply air ductwork served by air handling units. Thermal insulation shall be fibrous glass, 1 inch thick.

5. Thermally insulate all exhaust ductwork serving kitchen cooking equipment hoods. Thermal insulation shall be calcium silicate, 2 inches thick.

6. Thermally insulate all exhaust air ductwork within 10 feet of roof or wall penetrations. Thermal insulation shall be fibrous glass, 1 inch thick.

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