PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 2 Section "Sewerage and Drainage" for sanitary sewerage and storm drainage.
   2. Division 2 Section "Foundation Drainage Systems" for foundation drains.
   3. Division 2 Section "Septic Systems" for sewage disposal systems.
   4. Division 2 Section "Interceptors" for sewerage and drainage system interceptors.
   5. Section 15155 "Domestic Water and Drainage Piping Specialties" for drainage and vent piping system specialties.

1.2 SUMMARY

A. This Section includes sanitary drainage and vent piping, and storm drainage piping inside building and to locations indicated.

1.3 DEFINITIONS

A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building.

B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building.

C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping.

D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.

E. Force-Main Piping: Drainage piping, under pressure.

F. The following are industry abbreviations for plastic and other piping materials:
   2. EPDM: Ethylene-propylene-diene polymer, rubber.
   3. NBR: Acrylonitrile-butadiene rubber.
   4. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1.5 SUBMITTALS

A. Test Results and Reports: Specified in "Field Quality Control" Article.

1.6 QUALITY CONTROL

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

1.7 EXTRA MATERIALS

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

1. Rubber Gaskets for Hub-and-Spigot, Cast-Iron Soil Pipe, 4-Inch NPS (DN100) and Smaller: 12 of each class and size installed.

2. Rubber Gaskets for Hub-and-Spigot, Cast-Iron Soil Pipe, 5-Inch NPS (DN125) and Larger: 8 of each class and size installed.

3. Couplings for Hub-less, Cast-Iron Soil Piping, 4-Inch NPS (DN100) and Smaller: 8 of each type and size installed.

4. Couplings for Hub-less, Cast-Iron Soil Piping, 5-Inch NPS (DN125) and Larger: 6 of each type and size installed.

5. Keyed Couplings, 4-Inch NPS (DN100) and Smaller: 4 of each type and size installed. Include one extra gasket with each coupling.

6. Keyed Couplings, 5-Inch NPS (DN125) and Larger: 2 of each type and size installed. Include one extra gasket with each coupling.

7. Seals for Stainless-Steel Pipe, 6-Inch NPS (DN150) and Smaller: 6 of each size and material installed. Include backing ring.

8. Couplings for Stainless-Steel Pipe, 8-Inch NPS (DN200) and Larger: 6 of each size installed. Include EPDM elastomeric sleeve.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A 74, Service and Extra Heavy classes. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
C. Hub-less, Cast-Iron Soil Pipe: ASTM A 888 or CISPI 301.
D. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
E. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.
G. Galvanized Steel Pipe: ASTM A 53, Type E or S, Grade A or B, Schedule 40.
I. Stainless-Steel Pipe: ASME A112.3.1, fabricated from ASTM A 666, Type 304, stainless steel.
   1. 2- to 6-Inch NPS (DN50 to DN150): Socket-groove-end inlet and plain-end outlet. Include rubber seal with backing ring for socket-groove inlet.
      a. Seal Material for General Applications: EPDM rubber, unless otherwise indicated.
      b. Seal Material for Fluids Containing Gasoline or Oil: NBR, unless otherwise indicated.
   2. 8- to 12-Inch NPS (DN200 to DN300): With plain ends. Include manufacturer's standard, stainless-steel mechanical coupling, with EPDM elastomeric sleeve for each pipe section.
J. Ductile-Iron Pipe: AWWA C151 with mechanical- or push-on-joint bell and plain spigot end, unless plain, grooved, or flanged ends are indicated.
N. Cellular-Core, PVC Plastic Pipe: ASTM F 891, Schedule 40 (underground only).

2.2 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
C. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A 74, Service and Extra Heavy classes, hub and spigot. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
D. Hub-less, Cast-Iron, Soil-Pipe Fittings: CISPI 301.

F. Copper, Solder-Joint Drainage Fittings: ASME B16.23 cast copper or ASME B16.29 wrought copper.

G. Copper Sovent Fittings: ASME B16.32 cast copper, drainage-pattern aerator and deaerator.


I. Bronze Flanges: ASME B16.24, Class 150, bronze, with solder-joint end.


O. Ferrous Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, and flanged ends.

P. Ferrous, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

Q. Stainless-Steel Fittings: ASME A112.3.1 drainage pattern, fabricated from ASTM A 666, Type 304, stainless steel.
   1. 2- to 6-Inch NPS (DN50 to DN150): Socket-groove-end inlet and plain-end outlet. Include rubber seal with backing ring for each socket-groove inlet.
      a. Seal Material for General Applications: EPDM rubber, unless otherwise indicated.
      b. Seal Material for Fluids Containing Gasoline or Oil: NBR, unless otherwise indicated.
   2. 8- to 12-Inch NPS (DN200 to DN300): With plain ends. Include manufacturer's standard, stainless-steel mechanical coupling, with EPDM elastomeric sleeve for each fitting inlet.

R. Ductile-Iron, Mechanical- or Push-on-Joint Fittings: AWWA C110, ductile- or gray-iron standard pattern; or AWWA C153, ductile-iron compact pattern. Include AWWA C111
ductile- or gray-iron glands, rubber gaskets, and steel bolts with mechanical-joint fittings. Include AWWA C111 rubber gaskets with push-on-joint fittings.

S. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends conforming to AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

T. Ductile-Iron Deflection Fittings: Compound coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends conforming to AWWA C110 or AWWA C153. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

U. Ductile-Iron Expansion Joints: 3-piece assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections conforming to AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

V. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311 drain pipe patterns (underground only).

W. ABS Tubular Fittings: ASTM F 409 drainage pattern, with ends as required for application (underground only).

X. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns (underground only).

Y. PVC Plastic, Tubular Fittings: ASTM F 409 drainage pattern, with ends as required for application (underground only).

2.3 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Refer to Section 15050 "Basic Mechanical Materials and Methods" for commonly used joining materials.

C. Solder: ASTM B 32, "SILVABRITE", "BRIDGET" or approved equal, lead free with flux conforming to ASTM B 813.

D. Hub-less, Cast-Iron, Soil-Piping Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve or gasket with integral, center pipe stop. Include the following:

1. Heavy-Duty, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel housing or shield; and stainless-steel clamps. Include gasket.
   a. Clamp Width: 3 inches (75 mm) wide with 4 clamps, for piping 1-1/2- to 4-inch NPS (DN40 to DN100).
   b. Clamp Width: 4 inches (100 mm) wide with 6 clamps, for piping 5- to 10-inch NPS (DN125 to DN250).
2. Heavy-Duty, FM-Approved, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel housing; and stainless-steel clamps. Include gasket or bushing.
   a. Clamp Width: 3 inches (75 mm) wide with 2 clamps, for piping 1-1/2- to 4-inch NPS (DN40 to DN100).
   b. Clamp Width: 4 inches (100 mm) wide with 2 clamps, for piping 5- to 10-inch NPS (DN125 to DN250).
3. Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; and stainless-steel bolts and nuts. Include gasket.
4. Heavy-Duty, Stainless-Steel Couplings: ASTM A 666, Type 301, stainless-steel shield; and stainless-steel bands. Include sealing sleeve.
   a. Clamp Width: 3 inches (75 mm) wide with 4 clamps, for piping 1-1/2- to 4-inch NPS (DN40 to DN100).
   b. Clamp Width: 4 inches (100 mm) wide with 6 clamps, for piping 5- to 10-inch NPS (DN125 to DN250).

E. Copper, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

F. Ductile-Iron, Keyed Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

G. Steel, Keyed Couplings: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

H. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

I. Flexible, Transition Couplings for Underground, Non-pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.
   1. Sleeve Type for Plain-End Piping: Rubber or elastomeric sleeve and stainless-steel band assembly, fabricated to match outside diameters of piping to be joined. Include the following:
      b. Sleeves for Plastic Piping: ASTM F 477 elastomeric seal (underground only).
      c. Sleeves for Dissimilar Piping: Compatible with piping materials to be joined.
      d. Bands: Stainless steel, one at each pipe insert.
   2. Gasket Type for Dissimilar-End Piping: Rubber or elastomeric compression gasket, made to match inside diameter of pipe or hub, and outside diameter of adjoining pipe. Include the following:
      c. Gaskets for Dissimilar Piping: Compatible with piping materials to be joined.

2.4 POLYETHYLENE ENCASEMENT
SECTION 15150
SANITARY WASTE AND VENT PIPING

A. Polyethylene Encasement for Ductile-Iron Piping: ASTM A 674 or AWWA C105 polyethylene film, 0.008-inch (0.20-mm) minimum thickness, tube or sheet.

2.5 VALVES
A. Refer to Section 15110 "Valves" for general-duty valves. Use valves specified for "Domestic Water Systems" applications.

PART 3 - EXECUTION

3.1 EXCAVATION
A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS
A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
B. Flanges may be used on aboveground piping, unless otherwise indicated.
C. Aboveground, Soil, Waste, and Vent Piping: Use the following:
  1. Cast-iron Sovent fittings where indicated.
  2. Copper Sovent fittings where indicated.
  3. 1-1/2-Inch NPS (DN40): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
     a. Couplings: Heavy-duty, Type 304, stainless steel.
     b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
     c. Couplings: Heavy-duty, cast iron.
     d. Couplings: Heavy-duty, Type 301, stainless steel.
  4. 1-1/4- and 1-1/2-Inch NPS (DN32 and DN40): Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
  5. 1-1/4- and 1-1/2-Inch NPS (DN32 and DN40): Galvanized steel pipe and cast-iron, threaded drainage fittings.
  6. 2- to 4-Inch NPS (DN50 to DN100): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
  7. 2- to 4-Inch NPS (DN50 to DN100): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
     a. Couplings: Heavy-duty, Type 304, stainless steel.
     b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
     c. Couplings: Heavy-duty, cast iron.
     d. Couplings: Heavy-duty, Type 301, stainless steel.
  8. 2- to 4-Inch NPS (DN50 and DN100): Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
     a. Option for Vent Piping, 2-1/2- and 3-1/2-Inch NPS (DN65 and DN90): Hard copper water tube, Type M (Type C); copper, solder-joint pressure fittings; and soldered joints.
9. 2- to 4-Inch NPS (DN50 to DN100): Galvanized steel pipe and cast-iron, threaded drainage fittings.
10. 2- to 4-Inch NPS (DN50 to DN100): Stainless-steel pipe, stainless-steel fittings, and compression-gasket joint.
11. 5- and 6-Inch NPS (DN125 and DN150): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
12. 5- and 6-Inch NPS (DN125 and DN150): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
13. 5- and 6-Inch NPS (DN125 and DN150): Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
14. 5- and 6-Inch NPS (DN125 and DN150): Hard copper drainage tube; copper, grooved-end fittings; and copper, keyed couplings.
15. 5- and 6-Inch NPS (DN125 and DN150): Galvanized steel pipe and cast-iron, threaded drainage fittings.
16. 5- and 6-Inch NPS (DN125 and DN150): Stainless-steel pipe, stainless-steel fittings, and compression-gasket joint.
17. 8-Inch NPS (DN200): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
18. 8-Inch NPS (DN200): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
19. 8-Inch NPS (DN200): Hard-copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
20. 8-Inch NPS (DN200): Galvanized steel pipe and cast-iron, threaded drainage fittings.
21. 8-Inch NPS (DN200): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.
22. 8-Inch NPS (DN200): Stainless-steel pipe, stainless-steel fittings, and mechanical coupling joint.
23. 10-Inch NPS (DN250): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
24. 10-Inch NPS (DN250): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
25. 10-Inch NPS (DN250): Galvanized steel pipe and cast-iron, threaded fittings.
26. 10-Inch NPS (DN250): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.
27. 10-Inch NPS (DN250): Stainless-steel pipe, stainless-steel fittings, and mechanical coupling joint.

28. 12-Inch NPS (DN300): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

29. 12-Inch NPS (DN300): Galvanized steel pipe and cast-iron, threaded fittings.

30. 12-Inch NPS (DN300): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.


32. 15-Inch NPS (DN375): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

D. Underground, Soil, Waste, and Vent Piping: Use the following:

1. Cast-iron Sovent fittings where indicated.

2. Copper Sovent fittings where indicated.

3. 1-1/2-Inch NPS (DN40): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.

4. 1-1/2-Inch NPS (DN40): ABS plastic pipe, ABS socket fittings, and solvent-cemented joints.

5. 1-1/2-Inch NPS (DN40): Cellular-core, ABS plastic pipe; ABS socket fittings; and solvent-cemented joints.

6. 1-1/2-Inch NPS (DN40): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

7. 1-1/2-Inch NPS (DN40): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.

8. 2- to 4-Inch NPS (DN50 to DN100): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

9. 2- to 4-Inch NPS (DN50 to DN100): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

10. 2- to 4-Inch NPS (DN50 to DN100): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
    a. Couplings: Heavy-duty, Type 304, stainless steel.
    b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
    c. Couplings: Heavy-duty, cast iron.

11. 2- to 4-Inch NPS (DN50 to DN100): Stainless-steel pipe, stainless-steel fittings, and compression-gasket joint.

12. 2- to 4-Inch NPS (DN50 to DN100): ABS plastic pipe, ABS socket fittings, and solvent-cemented joints.

13. 2- to 4-Inch NPS (DN50 to DN100): Cellular-core, ABS plastic pipe; ABS socket fittings; and solvent-cemented joints.

14. 2- to 4-Inch NPS (DN50 to DN100): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

15. 2- to 4-Inch NPS (DN50 to DN100): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.
16. 5- and 6-Inch NPS (DN125 and DN150): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

17. 5- and 6-Inch NPS (DN125 and DN150): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

18. 5- and 6-Inch NPS (DN125 and DN150): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.

19. 5- and 6-Inch NPS (DN125 and DN150): Stainless-steel pipe, stainless-steel fittings, and compression-gasket joint.

20. 5- and 6-Inch NPS (DN125 and DN150): ABS plastic pipe, ABS socket fittings, and solvent-cemented joints.

21. 5- and 6-Inch NPS (DN125 and DN150): Cellular-core, ABS plastic pipe; ABS socket fittings; and solvent-cemented joints.

22. 5- and 6-Inch NPS (DN125 and DN150): PVC plastic pipe, PVC socket fittings; and solvent-cemented joints.

23. 5- and 6-Inch NPS (DN125 and DN150): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.

24. 8-Inch NPS (DN200): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

25. 8-Inch NPS (DN200): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

26. 8-Inch NPS (DN200): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.

27. 8-Inch NPS (DN200): Stainless-steel pipe, stainless-steel fittings, and mechanical coupling joint.

28. 8-Inch NPS (DN200): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

29. 8-Inch NPS (DN200): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.

30. 10-Inch NPS (DN250): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

31. 10-Inch NPS (DN250): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

32. 10-Inch NPS (DN250): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.

33. 10-Inch NPS (DN250): Stainless-steel pipe, stainless-steel fittings, and mechanical coupling joint.
34. 10-Inch NPS (DN250): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
35. 10-Inch NPS (DN250): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.
36. 12-Inch NPS (DN300): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
37. 12-Inch NPS (DN300): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.
38. 12-Inch NPS (DN300): Stainless-steel pipe, stainless-steel fittings, and mechanical coupling joint.
39. 12-Inch NPS (DN300): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
40. 12-Inch NPS (DN300): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.
41. 15-Inch NPS (DN375): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
42. 15-Inch NPS (DN375): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

E. Aboveground, Storm Drainage Piping: Use the following:
1. 2- to 4-Inch NPS (DN50 to DN100): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
2. 2- to 4-Inch NPS (DN50 to DN100): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
3. 2- to 4-Inch NPS (DN50 and DN100): Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
4. 2- to 4-Inch NPS (DN50 and DN100): Hard copper drainage tube; copper, grooved-end fittings; and copper, keyed couplings.
5. 2- to 4-Inch NPS (DN50 to DN100): Galvanized steel pipe and cast-iron, threaded drainage fittings.
6. 5- and 6-Inch NPS (DN125 and DN150): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
7. 5- and 6-Inch NPS (DN125 and DN150): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
8. 5- and 6-Inch NPS (DN125 and DN150): Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
9. 5- and 6-Inch NPS (DN125 and DN150): Galvanized steel pipe and cast-iron, threaded drainage fittings.
10. 8-Inch NPS (DN200): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
11. 8-Inch NPS (DN200): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
12. 8-Inch NPS (DN200): Hard copper drainage tube; copper, solder-joint drainage fittings; and soldered joints.
13. 8-Inch NPS (DN200): Galvanized steel pipe and cast-iron, threaded drainage fittings.
14. 8-Inch NPS (DN200): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.
15. 10-Inch NPS (DN250): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
16. 10-Inch NPS (DN250): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
   d. Couplings: Heavy-duty, Type 301, stainless steel.
17. 10-Inch NPS (DN250): Galvanized steel pipe and cast-iron, threaded fittings.
18. 12-Inch NPS (DN300): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
19. 12-Inch NPS (DN300): Galvanized steel pipe and cast-iron, threaded fittings.
20. 12-Inch NPS (DN300): Galvanized steel pipe; steel, grooved-end fittings; and steel, keyed couplings.
21. 15-Inch NPS (DN375): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.

F. Underground, Storm Drainage Piping: Use the following:
1. 3- and 4-Inch NPS (DN80 and DN100): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
2. 3- and 4-Inch NPS (DN80 and DN100): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.
3. 3- and 4-Inch NPS (DN80 and DN100): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
   a. Couplings: Heavy-duty, Type 304, stainless steel.
   b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
   c. Couplings: Heavy-duty, cast iron.
4. 3- and 4-Inch NPS (DN80 and DN100): ABS plastic pipe, ABS socket fittings, and solvent-cemented joints.
5. 3- and 4-Inch NPS (DN80 and DN100): Cellular-core, ABS plastic pipe; ABS socket fittings; and solvent-cemented joints.
6. 3- and 4-Inch NPS (DN80 and DN100): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

7. 3- and 4-Inch NPS (DN80 and DN100): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.

8. 5- and 6-Inch NPS (DN125 and DN150): Hub-and-spiogot, cast-iron soil pipe, Service class; hub-and-spiogot, cast-iron, soil-pipe fittings, Service class; and compression joints.

9. 5- and 6-Inch NPS (DN125 and DN150): Hub-and-spiogot, cast-iron soil pipe, Extra Heavy class; hub-and-spiogot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

10. 5- and 6-Inch NPS (DN125 and DN150): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
    a. Couplings: Heavy-duty, Type 304, stainless steel.
    b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
    c. Couplings: Heavy-duty, cast iron.

11. 5- and 6-Inch NPS (DN125 and DN150): ABS plastic pipe, ABS socket fittings, and solvent-cemented joints.

12. 5- and 6-Inch NPS (DN125 and DN150): Cellular-core, ABS plastic pipe; ABS socket fittings; and solvent-cemented joints.

13. 5- and 6-Inch NPS (DN125 and DN150): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

14. 5- and 6-Inch NPS (DN125 and DN150): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.

15. 8-Inch NPS (DN200): Hub-and-spiogot, cast-iron soil pipe, Service class; hub-and-spiogot, cast-iron, soil-pipe fittings, Service class; and compression joints.

16. 8-Inch NPS (DN200): Hub-and-spiogot, cast-iron soil pipe, Extra Heavy class; hub-and-spiogot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

17. 8-Inch NPS (DN200): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
    a. Couplings: Heavy-duty, Type 304, stainless steel.
    b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
    c. Couplings: Heavy-duty, cast iron.

18. 8-Inch NPS (DN200): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

19. 8-Inch NPS (DN200): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.

20. 10-Inch NPS (DN250): Hub-and-spiogot, cast-iron soil pipe, Service class; hub-and-spiogot, cast-iron, soil-pipe fittings, Service class; and compression joints.

21. 10-Inch NPS (DN250): Hub-and-spiogot, cast-iron soil pipe, Extra Heavy class; hub-and-spiogot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

22. 10-Inch NPS (DN250): Hub-less, cast-iron soil pipe; hub-less, cast-iron, soil-pipe fittings; and one of the following hub-less, cast-iron, soil-piping couplings:
    a. Couplings: Heavy-duty, Type 304, stainless steel.
    b. Couplings: Heavy-duty, FM-approved, Type 304, stainless steel.
    c. Couplings: Heavy-duty, cast iron.

23. 10-Inch NPS (DN250): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
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24. 10-Inch NPS (DN250): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.
25. 12-Inch NPS (DN300): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
26. 12-Inch NPS (DN300): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.
27. 12-Inch NPS (DN300): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
28. 12-Inch NPS (DN300): Cellular-core, PVC plastic pipe; PVC socket fittings; and solvent-cemented joints.
29. 15-Inch NPS (DN375): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
30. 15-Inch NPS (DN375): Hub-and-spigot, cast-iron soil pipe, Extra Heavy class; hub-and-spigot, cast-iron, soil-pipe fittings, Extra Heavy class; and compression joints.

G. Aboveground, Sewage Force Mains: Use the following:
1. 2- to 4-Inch NPS (DN50 and DN100): Hard copper water tube, Type L (Type B); copper, solder-joint pressure fittings; and soldered joints.
2. 2- to 4-Inch NPS (DN50 and DN100): Hard copper water tube, Type L (Type B); copper, grooved-end fittings; and copper, keyed couplings.
3. 2- to 4-Inch NPS (DN50 to DN100): Galvanized steel pipe and cast-iron, threaded fittings.
4. 5- and 6-Inch NPS (DN125 and DN150): Hard copper water tube, Type L (Type B); copper, grooved-end fittings; and copper, keyed couplings.
5. 5- and 6-Inch NPS (DN125 and DN150): Galvanized steel pipe and cast-iron, threaded fittings.

H. Underground, Sewage-Force-Main, Service Entrance Piping: Use the following:
1. 2- to 3-Inch NPS (DN50 to DN80): Soft copper water tube, Type K (Type A); wrought-copper, solder-joint pressure fittings; and soldered joints.
2. 2- to 3-Inch NPS (DN50 to DN80): Soft copper water tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.
3. 4- and 6-Inch NPS (DN100 and DN150): Ductile-iron pipe; ductile-iron, mechanical- or push-on-joint fittings; rubber gaskets; and mechanical or push-on joints.

3.3 VALVE APPLICATIONS
A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe, ball, or butterfly valves.

3.4 PIPING INSTALLATION, GENERAL
A. Refer to Section 15050 "Basic Mechanical Materials and Methods" for basic piping installation.
3.5 SERVICE ENTRANCE PIPING INSTALLATION

A. Refer to Division 2 Section "Sewerage and Drainage" for sanitary and storm sewer piping.

B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.

C. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.

D. Extend building sanitary drain, force-main piping and connect to sanitary sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.

E. Extend building storm drain, force-main piping and connect to storm sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.

F. Ductile-Iron, Force-Main, Service Entrance Piping: Comply with AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

H. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

3.6 DRAINAGE AND VENT PIPING INSTALLATION

A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

B. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
C. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS (DN80) and smaller; 1 percent downward in direction of flow for piping 4-inch NPS (DN100) and larger.
   2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Storm Building Drain: 1 percent downward in direction of flow.
   4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.
   5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

E. Install force mains at elevations indicated.

F. Install engineered, sanitary drainage and vent systems in locations indicated and as follows:
   4. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

G. Install engineered, controlled-flow, storm drainage systems in locations indicated. Comply with standards of authorities having jurisdiction.

H. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.

I. Install underground, ABS and PVC plastic drainage piping according to ASTM D 2321 (no plastic piping allowed above grade).

3.7 JOINT CONSTRUCTION

A. Refer to Section 15050 "Basic Mechanical Materials and Methods" for basic piping joint construction.

   1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
   2. Hub-less Joints: Make with rubber gasket and sleeve or clamp.

C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
D. ABS Piping Joints: Join drainage piping according to ASTM D 2661 (underground only).

E. PVC Piping Joints: Join drainage piping according to ASTM D 2665 (underground only).

F. ABS to PVC Piping Transition Joints: Make non-pressure transition joints between ABS and PVC drainage components, using fittings and procedure according to ASTM D 3138 (underground only).

G. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings (underground only).

3.8 VALVE INSTALLATION

A. Shutoff Valves: Install shutoff valve on each pump discharge and where indicated. Use gate or ball valves for piping 2-inch NPS (DN50) and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS (DN65) and larger.

B. Check Valves: Install swing check valve on each pump discharge, downstream from shutoff valve.

3.9 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 15060 "Hangers and Supports" for pipe hanger and support devices. Install the following:
   1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
   2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet (30 m) and less.
   3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet (30 m).
   4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet (30 m).
   5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet (30 m) or longer. Support pipe rolls on trapeze.
   6. Spring hangers, MSS Type 52, for supporting base of vertical runs.

B. Install supports according to Section 15060 "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
   1. 1-1/4-Inch NPS (DN32): Maximum horizontal spacing, 72 inches (1800 mm) with 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).
   2. 1-1/2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 96 inches (2400 mm) with 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).
3. 2-Inch NPS (DN65): Maximum horizontal spacing, 10 feet (3m) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).
4. 3- to 5-Inch NPS (DN80 to DN125): Maximum horizontal spacing, 10 feet (3 m) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).
5. 6-Inch NPS (DN150): Maximum horizontal spacing, 10 feet (3 m) with 5/8-inch (16-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).
6. 8-Inch NPS (DN200): Maximum horizontal spacing, 10 feet (3 m) with 3/4-inch (19-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).

F. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:
1. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, every other joint unless over 48 inches (1200 mm) then support every 18 inches max. from each joint. Use 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
2. 3-Inch NPS (DN80): Maximum horizontal spacing, 60 inches (1500 mm) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
3. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 60 inches (1500 mm) with 5/8-inch (16-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
4. 6-Inch NPS (DN150): Maximum horizontal spacing, 60 inches (1500 mm) with 3/4-inch (19-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
5. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 60 inches (1500 mm) with 7/8-inch (22-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
6. 15-Inch NPS (DN375): Maximum horizontal spacing, 60 inches (1500 mm) with 1-inch (25-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).

G. Install hangers for steel and ductile-iron piping with the following maximum spacing and minimum rod diameters:
1. 1-1/4-Inch NPS (DN32): Maximum horizontal spacing, 84 inches (2100 mm); 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
2. 1-1/2-Inch NPS (DN40): Maximum horizontal spacing, 108 inches (2700 mm) with 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
3. 2-Inch NPS (DN50): Maximum horizontal spacing, 10 feet (3 m) with 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
4. 2-1/2-Inch NPS (DN65): Maximum horizontal spacing, 11 feet (3.4 m) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
5. 3-Inch NPS (DN80): Maximum horizontal spacing, 12 feet (3.7 m) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
6. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 12 feet (3.7 m) with 5/8-inch (16-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
7. 6-Inch NPS (DN150): Maximum horizontal spacing, 12 feet (3.7 m) with 3/4-inch (19-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).
8. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 12 feet (3.7 m) with 7/8-inch (22-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).

9. 14- through 18-Inch NPS (DN350 through DN450): Maximum horizontal spacing, 12 feet (3.7 m) with 1-inch (25-mm) minimum rod diameter; maximum vertical spacing, 15 feet (4.5 m).

H. Install hangers for stainless-steel piping with the following maximum spacing and minimum rod diameters:

1. 2-Inch NPS (DN50): Maximum horizontal spacing, 84 inches (2100 mm) with 3/8-inch (10-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).

2. 3-Inch NPS (DN75): Maximum horizontal spacing, 96 inches (2400 mm) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).

3. 4-Inch NPS (DN100): Maximum horizontal spacing, 108 inches (2700 mm) with 1/2-inch (13-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).

4. 6-Inch NPS (DN150): Maximum horizontal spacing, 10 feet (3 m) with 5/8-inch (16-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).

5. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 10 feet (3 m) with 7/8-inch (22-mm) minimum rod diameter; maximum vertical spacing, 10 feet (3 m).

3.10 CONNECTIONS

A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage piping to service entrance piping, and extend to and connect to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 15410 "Plumbing Fixtures."

2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 15155 "Drainage Piping Specialties."

3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.

C. Connect force-main piping to service entrance piping, and extend to and connect to the following:

1. Sump Pumps: Connect force-main piping to sump-pump discharge.

2. Sewage Pumps: Connect force-main piping to sewage-pump discharge.

3.11 FIELD QUALITY CONTROL

A. Inspect drainage and vent piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
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2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head (30 kPa). Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.
3.12 CLEANING AND PROTECTING

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

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION