

## CHAPTER 30

# SANITARY DRAINAGE

### SECTION P3001 GENERAL

**P3001.1 Scope.** The provisions of this chapter shall govern the materials, design, construction and installation of sanitary drainage systems. Plumbing materials shall conform to the requirements of this chapter. The drainage, waste and vent (DWV) system shall consist of all piping for conveying wastes from plumbing fixtures, appliances and appurtenances, including fixture traps; above-grade drainage piping; below-grade drains within the building (building drain); below- and above-grade venting systems; and piping to the public sewer or private septic system.

**P3001.2 Protection from freezing.** No portion of the above grade DWV system other than vent terminals shall be located outside of a building, in attics or crawl spaces, concealed in outside walls, or in any other place subjected to freezing temperatures unless adequate provision is made to protect them from freezing by insulation or heat or both, except in localities having a winter design temperature above 32°F (0°C) (ASHRAE 97.5 percent column, winter, see Chapter 3).

**P3001.3 Flood-resistant installation.** In areas prone to flooding as established by Table R301.2(1), drainage, waste and vent systems shall be located and installed to prevent infiltration of floodwaters into the systems and discharges from the systems into floodwaters.

### SECTION P3002 MATERIALS

**P3002.1 Piping within buildings.** Drain, waste and vent (DWV) piping in buildings shall be as shown in Tables P3002.1(1) and P3002.1(2) except that galvanized wrought-iron or galvanized steel pipe shall not be used underground and shall be maintained not less than 6 inches (152 mm) above ground. Allowance shall be made for the thermal expansion and contraction of plastic piping.

**P3002.2 Building sewer.** Building sewer piping shall be as shown in Table P3002.2. Forced main sewer piping shall conform to one of the standards for ABS plastic pipe, copper or copper-alloy tubing, PVC plastic pipe or pressure-rated pipe listed in Table P3002.2.

**P3002.3 Fittings.** Fittings shall be approved and compatible with the type of piping being used and shall be of a sanitary or DWV design for drainage and venting as shown in Table P3002.3. Water pipe fittings shall be permitted in engineer-designed systems where the design indicates compliance with Section P3101.2.1.

**P3002.3.1 Drainage.** Drainage fittings shall have a smooth interior waterway of the same diameter as the piping served. All fittings shall conform to the type of pipe used. Drainage fittings shall have no ledges, shoulders or reductions which can retard or obstruct drainage flow in the piping. Threaded

drainage pipe fittings shall be of the recessed drainage type, black or galvanized. Drainage fittings shall be designed to maintain one-fourth unit vertical in 12 units horizontal (2-percent slope) grade.

**P3002.4 Other materials.** Sheet lead, lead bends, lead traps and sheet copper shall comply with Sections P3002.4.1 through P3002.4.3.

**P3002.4.1 Sheet lead.** Sheet lead for the following uses shall weigh not less than indicated below:

1. Flashing of vent terminals, 3 psf (15 kg/m<sup>2</sup>).
2. Prefabricated flashing for vent pipes, 2<sup>1</sup>/<sub>2</sub> psf (12 kg/m<sup>2</sup>).

**P3002.4.2 Lead bends and traps.** Lead bends and lead traps shall not be less than 1/<sub>8</sub>-inch (3 mm) wall thickness.

**P3002.4.3 Sheet copper.** Sheet copper for the following uses shall weigh not less than indicated below:

1. General use, 12 ounces per square feet (4 kg/m<sup>2</sup>).
2. Flashing for vent pipes, 8 ounces per square feet (2.5 kg/m<sup>2</sup>).

### SECTION P3003 JOINTS AND CONNECTIONS

**P3003.1 Tightness.** Joints and connections in the DWV system shall be gas tight and water tight for the intended use or pressure required by test.

**P3003.2 Prohibited joints.** Running threads and bands shall not be used in the drainage system. Drainage and vent piping shall not be drilled, tapped, burned or welded.

The following types of joints and connections shall be prohibited:

1. Cement or concrete.
2. Mastic or hot-pour bituminous joints.
3. Joints made with fittings not approved for the specific installation.
4. Joints between different diameter pipes made with elastomeric rolling O-rings.
5. Solvent-cement joints between different types of plastic pipe.
6. Saddle-type fittings.

**P3003.3 ABS plastic.** Joints between ABS plastic pipe or fittings shall comply with Sections P3003.3.1 through P3003.3.3.

**P3003.3.1 Mechanical joints.** Mechanical joints on drainage pipes shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed only in underground systems unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

**TABLE P3002.1(1)**  
**ABOVE-GROUND DRAINAGE AND VENT PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661; ASTM F 628; CSA B181.1
Brass pipe	ASTM B 43
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Coextruded composite ABS DWV schedule 40 IPS pipe (solid)	ASTM F 1488
Coextruded composite ABS DWV schedule 40 IPS pipe (cellular core)	ASTM F 1488
Coextruded composite PVC DWV schedule 40 IPS pipe (solid)	ASTM F 1488
Coextruded composite PVC DWV schedule 40 IPS pipe (cellular core)	ASTM F 1488; ASTM F 891
Coextruded composite PVC IPS-DR, PS140, PS200 DWV	ASTM F 1488
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306
Galvanized steel pipe	ASTM A 53
Polyolefin pipe	CSA B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D 2665; ASTM D 2949; CSA B181.2; ASTM F 1488
Stainless steel drainage systems, Types 304 and 316L	ASME A112.3.1

**TABLE P3002.1(2)**  
**UNDERGROUND BUILDING DRAINAGE AND VENT PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661; ASTM F 628; CSA B181.1
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Coextruded composite ABS DWV schedule 40 IPS pipe (solid)	ASTM F 1488
Coextruded composite ABS DWV schedule 40 IPS pipe (cellular core)	ASTM F 1488
Coextruded composite PVC DWV schedule 40 IPS pipe (solid)	ASTM F 1488
Coextruded composite PVC DWV schedule 40 IPS pipe (cellular core)	ASTM F 891; ASTM F 1488
Coextruded composite PVC IPS-DR, PS140, PS200 DWV	ASTM F 1488
Copper or copper alloy tubing (Type K, L, M or DWV)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306
Polyolefin pipe	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D 2665; ASTM D 2949; CSA B181.2
Stainless steel drainage systems, Type 316L	ASME A112.3.1

**P3003.3.2 Solvent cementing.** Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235, ASTM D 2661, ASTM F 628 or CSA B181.1. Solvent-cement joints shall be permitted above or below ground.

**P3003.3.3 Threaded joints.** Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

**P3003.4 Asbestos-cement.** Joints between asbestos-cement pipe or fittings shall be made with a sleeve coupling of the same composition as the pipe, sealed with an elastomeric ring conforming to ASTM D 1869.

**P3003.5 Brass.** Joints between brass pipe or fittings shall comply with Sections P3003.5.1 through P3003.5.3.

**P3003.5.1 Brazed joints.** All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

**P3003.5.2 Mechanical joints.** Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

**TABLE P3002.2  
BUILDING SEWER PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661; ASTM D 2751; ASTM F 628
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; ASTM A 888; CISPI 301
Coextruded composite ABS DWV schedule 40 IPS pipe (solid)	ASTM F 1488
Coextruded composite ABS DWV schedule 40 IPS pipe (cellular core)	ASTM F 1488
Coextruded composite PVC DWV schedule 40 IPS pipe (solid)	ASTM F 1488
Coextruded composite PVC DWV schedule 40 IPS pipe (cellular core)	ASTM F 1488; ASTM F 891
Coextruded composite PVC IPS-DR-PS DWV, PS140, PS200	ASTM F 1488
Coextruded composite ABS sewer and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM F 1488
Coextruded composite PVC sewer and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM F 1488
Coextruded composite PVC sewer and drain PS 25, PS 50, PS 100 (cellular core)	ASTM F 891
Concrete pipe	ASTM C 14; ASTM C 76; CSA A257.1M; CSA A257.2M
Copper or copper-alloy tubing (Type K or L)	ASTM B 75; ASTM B 88; ASTM B 251
Polyethylene (PE) plastic pipe (SDR-PR)	ASTM F 714
Polyolefin pipe	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV, SDR 26, SDR 35, SDR41, PS50 or PS100)	ASTM D 2665; ASTM D 2949; ASTM D 3034; ASTM F 1412; CSA B182.2; CSA B182.4
Stainless steel drainage systems, Types 304 and 316L	ASME A112.3.1
Vitrified clay pipe	ASTM C 425; ASTM C 700

**TABLE P3002.3  
PIPE FITTINGS**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 3311; CSA B181.1; ASTM D 2661
Cast-iron pipe	ASME B 16.12; ASTM A 74; ASTM A 888; CISPI 301
Coextruded composite ABS DWV schedule 40 IPS pipe (solid or cellular core)	ASTM D 2661; ASTM D 3311; ASTM F 628
Coextruded composite ABS DWV schedule 40 IPS-DR, PS 140, PS 200 (solid or cellular core)	ASTM D 2665; ASTM D 3311; ASTM F 891
Coextruded composite ABS sewer and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM D 2751
Coextruded composite PVC DWV schedule 40 IPS-DR, PS 140, PS200 (solid and cellular core)	ASTM D 2665; ASTM D 3311; ASTM F 891
Coextruded composite PVC sewer and drain DR-PS in PS35, PS50, PS100, PS140, PS200	ASTM D 3034
Copper or copper alloy	ASME B 16.23; ASME B 16.29
Gray iron and ductile iron	AWWA C 110
Polyolefin	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic pipe	ASTM D 3311; ASTM D 2665; ASTM F 1412; ASTM F 1866; CSA B 181.2; CSA B 182.4
Stainless steel drainage systems, Types 304 and 316L	ASME A112.3.1

**P3003.5.3 Threaded joints.** Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

**P3003.6 Cast iron.** Joints between cast-iron pipe or fittings shall comply with Sections P3003.6.1 through P3003.6.3.

**P3003.6.1 Caulked joints.** Joints for hub and spigot pipe shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation to a depth of not less than 1 inch (25 mm). The lead shall not recede more than  $\frac{1}{8}$  inch (3 mm) below the rim of the hub and shall be caulked tight. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. Acid-resistant rope and acidproof cement shall be permitted.

**P3003.6.2 Compression gasket joints.** Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C 564. Gaskets shall be compressed when the pipe is fully inserted.

**P3003.6.3 Mechanical joint coupling.** Mechanical joint couplings for hubless pipe and fittings shall comply with CISPI 310 or ASTM C 1277. The elastomeric sealing sleeve shall conform to ASTM C 564 or CSA B602 and shall have a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer's installation instructions.

**P3003.7 Concrete joints.** Joints between concrete pipe and fittings shall be made with an elastomeric seal conforming to ASTM C 443, ASTM C 1173, CSA A257.3M or CSA B602.

**P3003.8 Coextruded composite ABS pipe.** Joints between coextruded composite pipe with an ABS outer layer or ABS fittings shall comply with Sections P3003.8.1 and P3003.8.2.

**P3003.8.1 Mechanical joints.** Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.8.2 Solvent cementing.** Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235, ASTM D 2661, ASTM F 628 or CSA B181.1. Solvent-cement joints shall be permitted above or below ground.

**P3003.9 Coextruded composite PVC pipe.** Joints between coextruded composite pipe with a PVC outer layer or PVC fittings shall comply with Sections P3003.9.1 and P3003.9.2.

**P3003.9.1 Mechanical joints.** Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM D 3212. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.9.2 Solvent cementing.** Joint surfaces shall be clean and free from moisture. A purple primer that conforms to

ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564, CSA B137.3 or CSA B181.2 shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.

**P3003.10 Copper pipe.** Joints between copper or copper-alloy pipe or fittings shall comply with Sections P3003.10.1 through P3003.10.4.

**P3003.10.1 Brazed joints.** All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

**P3003.10.2 Mechanical joints.** Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.10.3 Soldered joints.** Solder joints shall be made in accordance with the methods of ASTM B 828. All cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32.

**P3003.10.4 Threaded joints.** Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

**P3003.11 Copper tubing.** Joints between copper or copper-alloy tubing or fittings shall comply with Sections P3003.11.1 through P3003.11.3.

**P3003.11.1 Brazed joints.** All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

**P3003.11.2 Mechanical joints.** Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.11.3 Soldered joints.** Solder joints shall be made in accordance with the methods of ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32.

**P3003.12 Steel.** Joints between galvanized steel pipe or fittings shall comply with Sections P3003.12.1 and P3003.12.2.

**P3003.12.1 Threaded joints.** Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

**P3003.12.2 Mechanical joints.** Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.13 Lead.** Joints between lead pipe or fittings shall comply with Sections P3003.13.1 and P3003.13.2.

**P3003.13.1 Burned.** Burned joints shall be uniformly fused together into one continuous piece. The thickness of the

joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe.

**P3003.13.2 Wiped.** Joints shall be fully wiped, with an exposed surface on each side of the joint not less than  $\frac{3}{4}$  inch (19 mm). The joint shall be at least  $\frac{3}{8}$  inch (9.5 mm) thick at the thickest point.

**P3003.14 PVC plastic.** Joints between PVC plastic pipe or fittings shall comply with Sections P3003.14.1 through P3003.14.3.

**P3003.14.1 Mechanical joints.** Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.14.2 Solvent cementing.** Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564, CSA B137.3 or CSA B181.2 shall be applied to all joint surfaces. The joint shall be made while the cement is wet, and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.

**P3003.14.3 Threaded joints.** Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

**P3003.15 Vitrified clay.** Joints between vitrified clay pipe or fittings shall be made with an elastomeric seal conforming to ASTM C 425, ASTM C 1173 or CSA B602.

**P3003.16 Polyolefin plastic.** Joints between polyolefin plastic pipe and fittings shall comply with Sections P3003.16.1 and P3003.16.2.

**P3003.16.1 Heat-fusion joints.** Heat-fusion joints for polyolefin pipe and tubing joints shall be installed with socket-type heat-fused polyolefin fittings or electrofusion polyolefin fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 1412 or CSA B181.3.

**P3003.16.2 Mechanical and compression sleeve joints.** Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.17 Polyethylene plastic pipe.** Joints between polyethylene plastic pipe and fittings shall be underground and shall comply with Section P3003.17.1 or P3003.17.2.

**P3003.17.1 Heat fusion joints.** Joint surfaces shall be clean and free from moisture. All joint surfaces shall be cut, heated to melting temperature and joined using tools specifically designed for the operation. Joints shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657 and the manufacturer's installation instructions.

**P3003.17.2 Mechanical joints.** Mechanical joints in drainage piping shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.18 Joints between different materials.** Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type conforming to ASTM C 1173, ASTM C 1460 or ASTM C 1461. Connectors and adapters shall be approved for the application and such joints shall have an elastomeric seal conforming to ASTM C 425, ASTM C 443, ASTM C 564, ASTM C 1440, ASTM D 1869, ASTM F 477, CSA A257.3M or CSA B602, or as required in Sections P3003.18.1 through P3003.18.6. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal. Joints shall be installed in accordance with the manufacturer's installation instructions.

**P3003.18.1 Copper or copper-alloy tubing to cast-iron hub pipe.** Joints between copper or copper-alloy tubing and cast-iron hub pipe shall be made with a brass ferrule or compression joint. The copper or copper-alloy tubing shall be soldered to the ferrule in an approved manner, and the ferrule shall be joined to the cast-iron hub by a caulked joint or a mechanical compression joint.

**P3003.18.2 Copper or copper-alloy tubing to galvanized steel pipe.** Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass converter fitting or dielectric fitting. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe.

**P3003.18.3 Cast-iron pipe to galvanized steel or brass pipe.** Joints between cast-iron and galvanized steel or brass pipe shall be made by either caulked or threaded joints or with an approved adapter fitting.

**P3003.18.4 Plastic pipe or tubing to other piping material.** Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting. Joints between plastic pipe and cast-iron hub pipe shall be made by a caulked joint or a mechanical compression joint.

**P3003.18.5 Lead pipe to other piping material.** Joints between lead pipe and other piping material shall be made by a wiped joint to a caulking ferrule, soldering nipple, or bushing or shall be made with an approved adapter fitting.

**P3003.18.6 Stainless steel drainage systems to other materials.** Joints between stainless steel drainage systems and other piping materials shall be made with approved mechanical couplings.

**P3003.19 Joints between drainage piping and water closets.** Joints between drainage piping and water closets or similar fixtures shall be made by means of a closet flange compatible with the drainage system material, securely fastened to a structurally firm base. The inside diameter of the drainage pipe shall not be used as a socket fitting for a four by three closet flange. The joint shall be bolted, with an approved gasket, flange to fixture connection complying with ASME A112.4.3 or setting compound between the fixture and the closet flange.

**SECTION P3004  
DETERMINING DRAINAGE FIXTURE UNITS**

**P3004.1 DWV system load.** The load on DWV-system piping shall be computed in terms of drainage fixture unit (d.f.u.) values in accordance with Table P3004.1.

**SECTION P3005  
DRAINAGE SYSTEM**

**P3005.1 Drainage fittings and connections.** Changes in direction in drainage piping shall be made by the appropriate use of sanitary tees, wyes, sweeps, bends or by a combination of these drainage fittings in accordance with Table P3005.1. Change in direction by combination fittings, heel or side inlets or increasers shall be installed in accordance with Table P3005.1 and Sections P3005.1.1 through P3005.1.4. based on the pattern of flow created by the fitting.

**TABLE P3004.1  
DRAINAGE FIXTURE UNIT (d.f.u.) VALUES FOR VARIOUS PLUMBING FIXTURES**

TYPE OF FIXTURE OR GROUP OF FIXTURES	DRAINAGE FIXTURE UNIT VALUE (d.f.u.) <sup>a</sup>
Bar sink	1
Bathtub (with or without shower head and/or whirlpool attachments)	2
Bidet	1
Clothes washer standpipe	2
Dishwasher	2
Floor drain <sup>b</sup>	0
Kitchen sink	2
Lavatory	1
Laundry tub	2
Shower stall	2
Water closet (1.6 gallons per flush)	3
Water closet (greater than 1.6 gallons per flush)	4
Full-bath group with bathtub (with 1.6 gallon per flush water closet, and with or without shower head and/or whirlpool attachment on the bathtub or shower stall)	5
Full-bath group with bathtub (water closet greater than 1.6 gallon per flush, and with or without shower head and/or whirlpool attachment on the bathtub or shower stall)	6
Half-bath group (1.6 gallon per flush water closet plus lavatory)	4
Half-bath group (water closet greater than 1.6 gallon per flush plus lavatory)	5
Kitchen group (dishwasher and sink with or without garbage grinder)	2
Laundry group (clothes washer standpipe and laundry tub)	3
Multiple-bath groups <sup>c</sup> :	
1.5 baths	7
2 baths	8
2.5 baths	9
3 baths	10
3.5 baths	11

For SI: 1 gallon = 3.785 L.

- a. For a continuous or semicontinuous flow into a drainage system, such as from a pump or similar device, 1.5 fixture units shall be allowed per gpm of flow. For a fixture not listed, use the highest d.f.u. value for a similar listed fixture.
- b. A floor drain itself adds no hydraulic load. However, where used as a receptor, the fixture unit value of the fixture discharging into the receptor shall be applicable.
- c. Add 2 d.f.u. for each additional full bath.

**TABLE P3005.1**  
**FITTINGS FOR CHANGE IN DIRECTION**

TYPE OF FITTING PATTERN	CHANGE IN DIRECTION		
	Horizontal to vertical <sup>c</sup>	Vertical to horizontal	Horizontal to horizontal
Sixteenth bend	X	X	X
Eighth bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X <sup>a</sup>	X <sup>a</sup>
Short sweep	X	X <sup>a,b</sup>	X <sup>a</sup>
Long sweep	X	X	X
Sanitary tee	X <sup>c</sup>	—	—
Wye	X	X	X
Combination wye and eighth bend	X	X	X

For SI: 1 inch = 25.4 mm.

a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.

b. Three inches and larger.

c. For a limitation on multiple connection fittings, see Section P3005.1.1.

**P3005.1.1 Horizontal to vertical (multiple connection fittings).** Double fittings such as double sanitary tees and tee-wyes or approved multiple connection fittings and back-to-back fixture arrangements that connect two or more branches at the same level shall be permitted as long as directly opposing connections are the same size and the discharge into directly opposing connections is from similar fixture types or fixture groups. Double sanitary tee patterns shall not receive the discharge of back-to-back water closets and fixtures or appliances with pumping action discharge.

**Exception:** Back-to-back water closet connections to double sanitary tee patterns shall be permitted where the horizontal developed length between the outlet of the water closet and the connection to the double sanitary tee is 18 inches (457 mm) or greater.

**P3005.1.2 Heel- or side-inlet quarter bends, drainage.** Heel-inlet quarter bends shall be an acceptable means of connection, except where the quarter bends serves a water closet. A low-heel inlet shall not be used as a wet-vented connection. Side-inlet quarter bends shall be an acceptable means of connection for both drainage, wet venting and stack venting arrangements.

**P3005.1.3 Heel- or side-inlet quarter bends, venting.** Heel-inlet or side-inlet quarter bends, or any arrangement of pipe and fittings producing a similar effect, shall be acceptable as a dry vent where the inlet is placed in a vertical position. The inlet is permitted to be placed in a horizontal position only where the entire fitting is part of a dry vent arrangement.

**P3005.1.4 Water closet connection between flange and pipe.** One-quarter bends 3 inches (76 mm) in diameter shall be acceptable for water closet or similar connections, provided a 4-inch by 3-inch (102 mm by 76 mm) flange is

installed to receive the closet fixture horn. Alternately, a 4-inch by 3-inch (102 mm by 76 mm) elbow shall be acceptable with a 4-inch (102 mm) flange.

**P3005.1.5 Dead ends.** Dead ends shall be prohibited except where necessary to extend a cleanout or as an approved part of a rough-in more than 2 feet (610 mm) in length.

**P3005.1.6 Provisions for future fixtures.** Where drainage has been roughed-in for future fixtures, the drainage unit values of the future fixtures shall be considered in determining the required drain sizes. Such future installations shall be terminated with an accessible permanent plug or cap fitting.

**P3005.1.7 Change in size.** The size of the drainage piping shall not be reduced in size in the direction of the flow. A 4-inch by 3-inch (102 mm by 76 mm) water closet connection shall not be considered as a reduction in size.

**P3005.2 Drainage pipe cleanouts.** Drainage pipe cleanouts shall comply with Sections P3005.2.1 through P3005.2.11.

**Exception:** These provisions shall not apply to pressurized building drains and building sewers that convey the discharge of automatic pumping equipment to a gravity drainage system.

**P3005.2.1 Materials.** Cleanouts shall be liquid and gas tight. Cleanout plugs shall be brass or plastic.

**P3005.2.2 Spacing.** Cleanouts shall be installed not more than 100 feet (30 480 mm) apart in horizontal drainage lines measured from the upstream entrance of the cleanout.

**P3005.2.3 Underground drainage cleanouts.** When installed in underground drains, cleanouts shall be extended vertically to or above finished grade either inside or outside the building.

**P3005.2.4 Change of direction.** Cleanouts shall be installed at each fitting with a change of direction more than 45 degrees (0.79 rad) in the building sewer, building drain and horizontal waste or soil lines. Where more than one change of direction occurs in a run of piping, only one cleanout shall be required in each 40 feet (12 192 mm) of developed length of the drainage piping.

**P3005.2.5 Accessibility.** Cleanouts shall be accessible. Minimum clearance in front of cleanouts shall be 18 inches (457 mm) on 3-inch (76 mm) and larger pipes, and 12 inches (305 mm) on smaller pipes. Concealed cleanouts shall be provided with access of sufficient size to permit removal of the cleanout plug and rodding of the system. Cleanout plugs shall not be concealed by permanent finishing material.

**P3005.2.6 Base of stacks.** Accessible cleanouts shall be provided near the base of each vertical waste or soil stack. Alternatively, such cleanouts shall be installed outside the building within 3 feet (914 mm) of the building wall.

**P3005.2.7 Building drain and building sewer junction.** There shall be a cleanout near the junction of the building drain and building sewer. This cleanout shall be either inside or outside the building wall, provided that it is brought up to finish grade or to the lowest floor level. An approved two-way cleanout shall be permitted to serve as the required

cleanout for both the building drain and the building sewer. The cleanout at the junction of the building drain and building sewer shall not be required where a cleanout on a 3-inch (76 mm) or larger diameter soil stack is located within a developed length of 10 feet (3048 mm) of the building drain and building sewer junction.

**P3005.2.8 Direction of flow.** Cleanouts shall be installed so that the cleanout opens to allow cleaning in the direction of the flow of the drainage line.

**P3005.2.9 Cleanout size.** Cleanouts shall be the same nominal size as the pipe they serve up to 4 inches (102 mm). For pipes larger than 4 inches (102 mm) nominal size, the minimum size of the cleanout shall be 4 inches (102 mm).

**Exceptions:**

1. "P" trap connections with slip joints or ground joint connections, or stack cleanouts that are not more than one pipe diameter smaller than the drain served, shall be permitted.
2. Cast-iron cleanouts sized in accordance with the referenced standards in Table P3002.3, ASTM A 74 for hub and spigot fittings or ASTM A 888 or CISPI 301 for hubless fittings.

**P3005.2.10 Cleanout equivalent.** A fixture trap or a fixture with integral trap, readily removable without disturbing concealed piping shall be acceptable as a cleanout equivalent.

**P3005.2.11 Connections to cleanouts prohibited.** Cleanout openings shall not be used for the installation of new fixtures except where approved and an acceptable alternate cleanout is provided.

**P3005.3 Horizontal drainage piping slope.** Horizontal drainage piping shall be installed in uniform alignment at uniform slopes not less than 1/4 unit vertical in 12 units horizontal (2-percent slope) for 2 1/2-inch (64 mm) diameter and less, and not less than 1/8 unit vertical in 12 units horizontal (1-percent slope) for diameters of 3 inches (76 mm) or more.

**P3005.4 Drain pipe sizing.** Drain pipes shall be sized according to drainage fixture unit (d.f.u.) loads. The size of the drainage piping shall not be reduced in size in the direction of flow. The following general procedure is permitted to be used:

1. Draw an isometric layout or riser diagram denoting fixtures on the layout.
2. Assign d.f.u. values to each fixture group plus individual fixtures using Table P3004.1.
3. Starting with the top floor or most remote fixtures, work downstream toward the building drain accumulating d.f.u. values for fixture groups plus individual fixtures for each branch. Where multiple bath groups are being added, use the reduced d.f.u. values in Table P3004.1, which take into account probability factors of simultaneous use.
4. Size branches and stacks by equating the assigned d.f.u. values to pipe sizes shown in Table P3005.4.1.
5. Determine the pipe diameter and slope of the building drain and building sewer based on the accumulated d.f.u. values, using Table P3005.4.2.

**P3005.4.1 Fixture branch and stack sizing.**

1. Branches and stacks shall be sized according to Table P3005.4.1. Below grade drain pipes shall not be less than 1 1/2 inches (38 mm) in diameter.
2. Minimum stack size. Drain stacks shall not be smaller than the largest horizontal branch connected.

**Exceptions:**

1. A 4-inch by 3-inch (102 mm by 76 mm) closet bend or flange.
2. A 4-inch (102 mm) closet bend into a 3-inch (76 mm) stack tee shall be acceptable (see Section P3005.1.4).

**TABLE P3005.4.1  
MAXIMUM FIXTURE UNITS ALLOWED TO BE CONNECTED  
TO BRANCHES AND STACKS**

NOMINAL PIPE SIZE (inches)	ANY HORIZONTAL FIXTURE BRANCH	ANY ONE VERTICAL STACK OR DRAIN
1 1/4 <sup>a</sup>	—	—
1 1/2 <sup>b</sup>	3	4
2 <sup>b</sup>	6	10
2 1/2 <sup>b</sup>	12	20
3	20	48
4	160	240

For SI: 1 inch = 25.4 mm.

a. 1 1/4-inch pipe size limited to a single-fixture drain or trap arm. See Table P3201.7.

b. No water closets.

**P3005.4.2 Building drain and sewer size and slope.** Pipe sizes and slope shall be determined from Table P3005.4.2 on the basis of drainage load in fixture units (d.f.u.) computed from Table P3004.1.

**TABLE P3005.4.2  
MAXIMUM NUMBER OF FIXTURE UNITS ALLOWED TO BE  
CONNECTED TO THE BUILDING DRAIN,  
BUILDING DRAIN BRANCHES OR THE BUILDING SEWER**

DIAMETER OF PIPE (inches)	SLOPE PER FOOT		
	1/8 inch	1/4 inch	1/2 inch
1 1/2 <sup>a,b</sup>	—	Note a	Note a
2 <sup>b</sup>	—	21	27
2 1/2 <sup>b</sup>	—	24	31
3	36	42	50
4	180	216	250

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. 1 1/2-inch pipe size limited to a building drain branch serving not more than two waste fixtures, or not more than one waste fixture if serving a pumped discharge fixture or garbage grinder discharge.

b. No water closets.

**P3005.5 Connections to offsets and bases of stacks.** Horizontal branches shall connect to the bases of stacks at a point located not less than 10 times the diameter of the drainage stack downstream from the stack. Horizontal branches shall connect to horizontal stack offsets at a point located not less than 10

times the diameter of the drainage stack downstream from the upper stack.

### SECTION P3006 SIZING OF DRAIN PIPE OFFSETS

**P3006.1 Vertical offsets.** An offset in a vertical drain, with a change of direction of 45 degrees (0.79 rad) or less from the vertical, shall be sized as a straight vertical drain.

**P3006.2 Horizontal offsets above the lowest branch.** A stack with an offset of more than 45 degrees (0.79 rad) from the vertical shall be sized as follows:

1. The portion of the stack above the offset shall be sized as for a regular stack based on the total number of fixture units above the offset.
2. The offset shall be sized as for a building drain in accordance with Table P3005.4.2.
3. The portion of the stack below the offset shall be sized as for the offset or based on the total number of fixture units on the entire stack, whichever is larger.

**P3006.3 Horizontal offsets below the lowest branch.** In soil or waste stacks below the lowest horizontal branch, there shall be no change in diameter required if the offset is made at an angle not greater than 45 degrees (0.79 rad) from the vertical. If an offset greater than 45 degrees (0.79 rad) from the vertical is made, the offset and stack below it shall be sized as a building drain (see Table P3005.4.2).

### SECTION P3007 SUMPS AND EJECTORS

**P3007.1 Sewage ejectors or sewage pumps.** A sewage ejector, sewage pump, or grinder pump receiving discharge from a water closet shall have minimum discharge velocity of 1.9 feet per second (0.579 m/s) throughout the discharge piping to the point of connection with a gravity building drain, gravity sewer or pressure sewer system. A nongrinding pump or ejector shall be capable of passing a 1½-inch-diameter (38 mm) solid ball, and the discharge piping shall be not less than 2 inches (51 mm) in diameter. The discharge piping of grinding pumps shall be not less than 1¼ inches (32 mm) in diameter. A check valve and a gate valve located on the discharge side of the check valve shall be installed in the pump or ejector discharge piping between the pump or ejector and the drainage system. Access shall be provided to such valves. Such valves shall be located above the sump cover or, where the discharge pipe from the ejector is below grade, the valves shall be accessibly located outside the sump below grade in an access pit with a removeable access cover.

**Exception:** Macerating toilet systems shall be permitted to have the discharge pipe sized in accordance with manufacturer's instructions, but not less than 0.75 inch (19 mm) in diameter.

**P3007.2 Building drains below sewer (building subdrains).** Building drains which cannot be discharged to the sewer by gravity flow shall be discharged into a tightly covered and vented sump from which the contents shall be lifted and dis-

charged into the building gravity drainage system by automatic pumping equipment.

**P3007.2.1 Drainage piping.** The system of drainage piping below the sewer level shall be installed and vented in a manner similar to that of the gravity system. Only such drains that must be lifted for discharge shall be discharged into sumps. All other drains shall be discharged by gravity.

**Exception:** Macerating toilet systems shall be permitted as an alternate to the sewage pump or ejector system. The macerating toilet shall comply with ASME A112.3.4 or CSA B45.9 and shall be installed in accordance with the manufacturers' instructions.

### SECTION P3008 BACKWATER VALVES

**P3008.1 General.** Fixtures that have flood level rims located below the elevation of the next upstream manhole cover of the public sewer serving such fixtures shall be protected from backflow of sewage by installing an approved backwater valve. Fixtures having flood level rims above the elevation of the next upstream manhole shall not discharge through the backwater valve. Backwater valves shall be provided with access.

**P3008.2 Construction.** Backwater valves shall have noncorrosive bearings, seats and self-aligning discs, and shall be constructed to ensure a positive mechanical seal. Valve access covers shall be water tight.

