

## 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.** Pipe fittings shall be *approved* for installation with the piping material installed and shall comply with the applicable standards listed in Table P3002.3.

**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, 2½ psf (12 kg/m<sup>2</sup>).

**P3002.4.2 Lead bends and traps.** Lead bends and lead traps shall not be less than ⅛-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.

**P3003.1.1 Threaded joints, general.** Pipe and fitting threads shall be tapered.

**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

PIPE	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Brass pipe	ASTM B 43
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
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 in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2665; ASTM F 891; CSA B181.2; ASTM F 1488
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D. and a solid, cellular core or composite wall	ASTM D 2949, ASTM F 1488
Stainless steel drainage systems, Types 304 and 316L	ASME A 112.3.1

For SI: 1 inch = 25.4 mm.

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

PIPE	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
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 in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D. and a solid, cellular core or composite wall	ASTM D 2949; ASTM F 1488
Stainless steel drainage systems, Type 316L	ASME A 112.3.1

For SI: 1 inch = 25.4 mm.

**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 in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; ASTM A 888; CISPI 301
Acrylonitrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters, including SDR 42 (PS 20), PS35, SDR 35 (PS 45), PS50, PS100, PS140, SDR 23.5 (PS 150) and PS200; with a solid, cellular core or composite wall	ASTM F 1488; ASTM D 2751
Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters, including PS 25, SDR 41 (PS 28), PS 35, SDR 35 (PS 46), PS 50, PS 100, SDR 26 (PS 115), PS140 and PS 200; with a solid, cellular core or composite wall	ASTM F 891; ASTM F 1488; ASTM D 3034; CSA B182.2; CSA B182.4
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 in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with solid, cellular core or composite wall	ASTM D 2665; ASTM D 2949; ASTM D 3034; ASTM F 1412; CSA B182.2; CSA B182.4
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D. and a solid, cellular core or composite wall	ASTM D 2949, ASTM F 1488
Stainless steel drainage systems, Types 304 and 316L	ASME A 112.3.1
Vitrified clay pipe	ASTM C 425; ASTM C 700

For SI: 1 inch = 25.4 mm.

**TABLE P3002.3  
PIPE FITTINGS**

PIPE MATERIAL	FITTING STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters	ASTM D 2661; ASTM D 3311; ASTM F 628; CSA B181.1
Asbestos cement	ASTM C 428
Cast-iron	ASME B 16.4; ASME B 16.12; ASTM A 74; ASTM A 888; CISPI 301
Acrylonitrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters	ASTM D 2751
Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters	ASTM D 3034
Copper or copper alloy	ASME B 16.15; ASME B 16.18; ASME B 16.22; ASME B 16.23; ASME B 16.26; ASME B 16.29
Gray iron and ductile iron	AWWA C 110
Polyolefin	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic in IPS diameters	ASTM D 2665; ASTM D 3311; ASTM F 1866
Polyvinyl chloride (PVC) plastic pipe with a 3.25 inch O.D.	ASTM D 2949
PVC fabricated fittings	ASTM F 1866
Stainless steel drainage systems, Types 304 and 316L	ASME A 112.3.1
Vitrified clay	ASTM C 700

For SI: 1 inch = 25.4 mm.

## CHAPTER 7 SANITARY DRAINAGE

### SECTION 701 GENERAL

**701.1 Scope.** The provisions of this chapter shall govern the materials, design, construction and installation of sanitary drainage systems.

**701.2 Sewer required.** Every building in which plumbing fixtures are installed and all premises having drainage piping shall be connected to a public sewer, where available, or an approved private sewage disposal system.

R 408.30730

**701.3 Separate sewer connection.** A building having plumbing fixtures installed and intended for human habitation, occupancy or use on premises abutting on a street, alley or easement in which there is a *public sewer* shall have a separate connection with the *sewer*. Where located on the same lot, multiple buildings shall not be prohibited from connecting to a common *building sewer* that connects to the *public sewer*.

**701.4 Sewage treatment.** Sewage or other waste from a plumbing system that is deleterious to surface or subsurface waters shall not be discharged into the ground or into any waterway unless it has first been rendered innocuous through subjection to an *approved* form of treatment.

**701.5 Damage to drainage system or public sewer.** Wastes detrimental to the *public sewer* system or to the functioning of the sewage-treatment plant shall be treated and disposed of in accordance with Section 1003 as directed by the code official.

**701.6 Tests.** The sanitary drainage system shall be tested in accordance with Section 312.

**701.7 Connections.** Direct connection of a steam exhaust, blowoff or drip pipe shall not be made with the building drainage system. Waste water where discharged into the building drainage system shall be at a temperature not greater than 140°F (60°C). Where higher temperatures exist, *approved* cooling methods shall be provided.

**701.8 Engineered systems.** Engineered sanitary drainage systems shall conform to the provisions of Sections 316 and 714.

**701.9 Drainage piping in food service areas.** Exposed soil or waste piping shall not be installed above any working, storage or eating surfaces in food service establishments.

### SECTION 702 MATERIALS

**702.1 Above-ground sanitary drainage and vent pipe.** Above-ground soil, waste and vent pipe shall conform to one of the standards listed in Table 702.1.

**702.2 Underground building sanitary drainage and vent pipe.** Underground building sanitary drainage and vent pipe shall conform to one of the standards listed in Table 702.2.

TABLE 702.1  
ABOVE-GROUND DRAINAGE AND VENT PIPE

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Brass pipe	ASTM B 43
Cast-iron pipe	ASTM A 74; ASTM A 888; CISPI 301
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
Glass pipe	ASTM C 1053
Polyolefin pipe	ASTM F 1412; CSA B181.3
Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200), and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2
Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core or composite wall	ASTM D 2949, ASTM F 1488
Polyvinylidene fluoride (PVDF) plastic pipe	ASTM F 1673; CSA B181.3
Stainless steel drainage systems, Types 304 and 316L	ASME A112.3.1

**702.3 Building sewer pipe.** Building sewer pipe shall conform to one of the standards listed in Table 702.3.

**702.4 Fittings.** Pipe fittings shall be *approved* for installation with the piping material installed and shall comply with the applicable standards listed in Table 702.4.

**702.5 Chemical waste system.** A chemical waste system shall be completely separated from the sanitary drainage system. The chemical waste shall be treated in accordance with Section 803.2 before discharging to the sanitary drainage system. Separate drainage systems for chemical wastes and vent pipes shall be of an *approved* material that is resistant to corrosion and degradation for the concentrations of chemicals involved.

**702.6 Lead bends and traps.** Lead bends and traps shall not be less than  $\frac{1}{8}$  inch (3.2 mm) wall thickness.



**TABLE 702.2**  
**UNDERGROUND BUILDING DRAINAGE AND VENT PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core, or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; ASTM A 888; CISPI 301
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 in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core, or composite wall	ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2
Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core, or composite wall	ASTM D 2949, ASTM F 1488
Polyvinylidene fluoride (PVDF) plastic pipe	ASTM F 1673; CSA B181.3
Stainless steel drainage systems, Type 316L	ASME A 112.3.1

*ATTACHMENT 1*  
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*CODE*

**TABLE 702.3**  
**BUILDING SEWER PIPE**

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1
Acrylonitrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters, including SDR 42 (PS 20), PS 35, SDR 35 (PS 45), PS 50, PS 100, PS 140, SDR 23.5 (PS 150) and PS 200; with a solid, cellular core or composite wall	ASTM F 1488; ASTM D 2751
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; ASTM A 888; CISPI 301
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
Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall	ASTM D 2665; ASTM F 891; ASTM F 1488
Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters, including PS 25, SDR 41 (PS 28), PS 35, SDR 35 (PS 46), PS 50, PS 100, SDR 26 (PS 115), PS 140 and PS 200; with a solid, cellular core or composite wall	ASTM F 891; ASTM F 1488; ASTM D 3034; CSA B182.2; CSA B182.4
Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core or composite wall.	ASTM D 2949, ASTM F 1488
Polyvinylidene fluoride (PVDF) plastic pipe	ASTM F 1673; CSA B181.3
Stainless steel drainage systems, Types 304 and 316L	ASME A112.3.1
Vitrified clay pipe	ASTM C 4; ASTM C 700

ASSE—continued

1011—04	Performance Requirements for Hose Connection Vacuum Breakers	Table P2902.3, P2902.3.2
1012—02	Performance Requirements for Backflow Preventers with Intermediate Atmospheric Vent	Table P2902.3, P2902.3.3, P2902.5.1, P2902.5.5
1013—05	Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers	Table P2902.3, P2902.3.5, P2902.5.1, P2902.5.5
1015—05	Performance Requirements For Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies	Table P2902.3, P2902.3.6
1016—96	Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations	Table P2701.1, P2708.3, P2722.2
1017—03	Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems	P2802.2
1019—04	Performance Requirements for Wall Hydrants, Freeze Resistant, Automatic Draining Types	Table P2701.1, P2902.3
1020—04	Performance Requirements for Pressure Vacuum Breaker Assembly	Table P2902.3, P2902.3.4
1023—79	Performance Requirements for Hot Water Dispensers Household Storage Type-electrical	Table P2701.1
1024—04	Performance Requirements for Dual Check Backflow Preventers	Table P2902.3
1025—78	Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-siphon Type, Residential Applications	Table P2701.1
1035—02	Performance Requirements for Laboratory Faucet Backflow Preventers	Table P2902.3, P2902.3.2
1037—90	Performance Requirements for Pressurized Flushing Devices (Flushometer) for Plumbing Fixtures	Table P2701.1
1047—05	Performance Requirements for Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies	Table P2902.3, P2902.3.5
1048—05	Performance Requirements for Double Check Detector Fire Protection Backflow Prevention Assemblies	Table P2902.3, P2902.3.6
1050—02	Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems	P3114.1
1051—02	Performance Requirements for Individual and Branch Type Air Admittance Valves for Plumbing Drainage Systems	P3114.1
1052—04	Performance Requirements for Hose Connection Backflow Preventers	Table P2701.1, Table P2902.3, P2902.3.2
1056—01	Performance Requirements for Spill Resistant Vacuum Breakers	Table P2902.3, P2902.3.4
1060—96	Performance Requirements for Outdoor Enclosures for Fluid Conveying Components	P2902.6.1
1061—06	Performance Requirements for Removable and Nonremovable Push Fit Fittings	Table P2905.6
1062—97	Performance Requirements for Temperature Actuated, Flow Reduction (TAFR) Valves for Individual Supply Fittings	Table P2701.1, P2724.1
1066—97	Performance Requirements for Individual Pressure Balancing In-line Valves for Individual Fixture Fittings	Table P2701.1, P2722.4
1070—04	Performance Requirements for Water Temperature Limiting Devices	P2713.3, P2721.2

# ASTM

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Standard reference number	Title	Referenced in code section number
A 36/A 36M—05	Specification for Carbon Structural Steel	R606.15, R611.5.2.2
A 53/A 53M—06a	Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated Welded and Seamless	G2414.4.2, Table M2101.1, Table P2905.4, Table P2905.5, Table P3002.1(1)
A 74—06	Specification for Cast Iron Soil Pipe and Fittings	Table P3002.1(1), Table P3002.1(2), Table P3002.2, Table P3002.3, P3005.2.9, Table P3302.1
A 82/A 82M—05a	Specification for Steel Wire, Plain, for Concrete Reinforcement	R606.15
A 106/A 106M—06a	Specification for Seamless Carbon Steel Pipe for High Temperature Service	G2414.4.2, Table M2101.1
A 153/A 153M—05	Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware	R317.3, Table R606.15.1
A 167—99(2004)	Specification for Stainless and Heat-resisting Chromium-nickel Steel Plate, Sheet and Strip	R606.15, Table R606.15.1
A 240/A 240M—07	Standard Specification for Chromium and Chromium-nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications	Table R905.10.3(1)
A 254—97(2002)	Specification for Copper Brazed Steel Tubing	G2414.5.1, Table M2101.1
A 307—04e01	Specification for Carbon Steel Bolts and Studs, 6000 psi Tensile Strength	R611.5.2.2
A 312/A 312M—06	Specification for Seamless and Welded Austenitic Stainless Steel Pipes	Table P2905.4, Table P2905.5, Table P2905.6, P2905.12.2

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A 463/A 463M—05	Standard Specification for Steel Sheet, Aluminum-coated by the Hot-dip Process	Table R905.10.3(2)
A 510—06	Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel	R606.15
A 539—99	Specification for Electric-resistance-welded Coiled Steel Tubing for Gas and Fuel Oil Lines	M2202.1
A 615/A 615M—04a	Specification for Deformed and Plain Billet-steel Bars for Concrete Reinforcement	R402.3.1, R404.1.2.3.7.1, R611.5.2.1
A 641/A 641M—03	Specification for Zinc-coated (Galvanized) Carbon Steel Wire	Table R606.15.1
A 653/A 653M—07	Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-iron Alloy-coated (Galvanized) by the Hot-dip Process	M1601.1.1, R317.3.1, R505.2.1, R505.2.3, R603.2.1, R603.2.3, Table R606.15.1, R611.5.2.3, R804.2.1, R804.2.3, Table R905.10.3(1), Table R905.10.3(2)
A 706/A 706M—05a	Specification for Low-alloy Steel Deformed and Plain Bars for Concrete Reinforcement	R402.3.1, R404.1.2.3.7.1, R611.5.2.1
A 755/A 755M—07	Specification for Steel Sheet, Metallic Coated by the Hot-dip Process and Prepainted by the Coil-coating Process for Exterior Exposed Building Products	Table R905.10.3(2)
A 778—01	Specification for Welded Unannealed Austenitic Stainless Steel Tubular Products	Table P2905.4, Table P2905.5, Table P2905.6
A 792/A 792M—06a	Specification for Steel Sheet, 55% Aluminum-zinc Alloy-coated by the Hot-dip Process	R505.2.1, R505.2.3, R603.2.1, R603.2.3, R611.5.2.3, R804.2.1, R804.2.3, Table R905.10.3 (2)
A 875/A 875M—06	Specification for Steel Sheet, Zinc-5%, Aluminum Alloy-coated by the Hot-dip Process	R611.5.3.2, Table R905.10.3 (2)
A 888—07a	Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Application	Table P3002.1(1), Table P3002.1(2), Table P3002.2, Table P3002.3, P3005.2.9, Table P3302.1
A 924/A 924M—07	Standard Specification for General Requirements for Steel Sheet, Metallic-coated by the Hot-Dip Process	Table R905.10.3(1)
A 951—06	Specification for Steel Wire Masonry Joint Reinforcement	R606.15
A 996/A 996M—06a	Specifications for Rail-steel and Axel-steel Deformed Bars for Concrete Reinforcement	R404.1.2.3.7, R404.1.2.3.7.1, R611.5.2.1, Table R611.5.4(2)
A 1003/A 1003M—05	Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic-coated for Cold-formed Framing Members	R505.2.1, R505.2.3, R603.2.1, R603.2.3, R804.2.1, R804.2.3
A 32—04	Specification for Solder Metal	P3003.10.3, P3003.11.3
A 42—02e01	Specification for Seamless Copper Pipe, Standard Sizes	Table M2101.1, Table P2905.4, Table P2905.5, Table P3002.1(1)
A 43—98 (2004)	Specification for Seamless Red Brass Pipe, Standard Sizes	G2413.5.2, Table M2101.1, Table P2905.4, Table P3002.1(1)
A 75—02	Specification for Seamless Copper Tube	Table M2101.1, Table P2905.4, Table P2905.5, Table P3002.1(1), Table P3002.1(2), Table P3002.2
A 88—03	Specification for Seamless Copper Water Tube	G2414.5.2, Table M2101.1, Table P2905.4, Table P2905.5, Table P3002.1(1), Table P3002.1(2), Table P3002.2
A 101—02	Specification for Lead-coated Copper Sheet and Strip for Building Construction	Table R905.2.8.2, Table R905.10.3(1)
A 135—02	Specification for Seamless Brass Tube	Table M2101.1
A 209—06	Specification for Aluminum and Aluminum-alloy Sheet and Plate	Table R905.10.3(1)
A 227—04	Specification for Hard-drawn Copper-clad Steel Wire	R606.15
A 251—02e01	Specification for General Requirements for Wrought Seamless Copper and Copper-alloy Tube	Table M2101.1, Table P2905.4, Table P2905.5, Table P3002.1(1), Table P3002.1(2), Table P3002.2
A 302—02	Specification for Threadless Copper Pipe, Standard Sizes	Table M2101.1, Table P2905.4, Table P2905.5, Table P3002.1(1)
A 306—02	Specification for Copper Drainage Tube (DWV)	Table M2101.1, Table P3002.1(1), Table P3002.1(2), Table P3002.2
A 370—03	Specification for Copper Sheet and Strip for Building Construction	Table P2701.1, Table R905.2.8.2, Table R905.10.3(1)
A 447—07	Specification for Welded Copper Tube	Table P2904.4, Table P2905.5
A 595—04	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel	R317.3.1, R317.3.3
A 313—00e01	Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube	Table M2101.1, P2905.14, P3003.10.3, P3003.11.3
A 328—02	Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings	P2905.14, P3003.10.3, P3003.11.3
A 1—04e01	Specification for Clay Drain Tile and Perforated Clay Drain Tile	Table P3302.1
A 1—03	Specification for Quicklime for Structural Purposes	R702.2.1
A 4—07	Specification for Concrete Sewer, Storm Drain and Culvert Pipe	Table P3002.2

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C 28/C 28M—00(2005)	Specification for Gypsum Plasters	R702.2.1
C 33—03	Specification for Concrete Aggregates	R403.4.1
C 34—03	Specification for Structural Clay Load-bearing Wall Tile	Table R301.2.1
C 35—01(2005)	Specification for Inorganic Aggregates for Use in Gypsum Plaster	R702.2.1
C 36/C 36M—03	Specification for Gypsum Wallboard	R702.3.1
C 37/C 37M—01	Specification for Gypsum Lath	R702.2.1, R702.2.2
C 55—06e01	Specification for Concrete Building Brick	R202, Table R301.2.1
C 59/C 59M—00 (2006)	Specification for Gypsum Casting and Molding Plaster	R702.2.1
C 61/C 61M—00 (2006)	Specification for Gypsum Keene's Cement	R702.2.1
C 62—05	Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)	R202, Table R301.2.1
C 73—05	Specification for Calcium Silicate Face Brick (Sand Lime Brick)	R202, Table R301.2.1
C 76—07	Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe	Table P3002.2
C 79—04a	Specification for Treated Core and Nontreated Core Gypsum Sheathing Board	R702.3.1
C 90—06b	Specification for Load-bearing Concrete Masonry Units	Table R301.2.1
C 91—05	Specification for Masonry Cement	R702.2.1
C 94/C 94M—07	Specification for Ready-mixed Concrete	R404.1.2.3.2, R611.5.1.1
C 129—06	Specification for Nonload-bearing Concrete Masonry Units	Table R301.2.1
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C 145—85	Specification for Solid Load-bearing Concrete Masonry Units	R202, Table R301.2.1
C 150—07	Specification for Portland Cement	R702.2.2
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C 203—05a	Standard Test Methods for Breaking Load and Flexural Properties of Block-type Thermal Insulation	Table R613.3.1
C 207—06	Specification for Hydrated Lime for Masonry Purposes	Table R607.1
C 208—95 (2001)	Specification for Cellulosic Fiber Insulating Board	Table R602.3.1
C 216—07	Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)	R202, Table R301.2.1
C 270—07	Specification for Mortar for Unit Masonry	R607.1, AE602
C 272—01	Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions	Table R613.3.1
C 273—00e1	Standard Test Method for Shear Properties of Sandwich Core Materials	Table R613.3.1
C 296—(2004)e01	Specification for Asbestos Cement Pressure Pipe	Table P2905.4
C 315—07	Specification for Clay Flue Liners and Chimney Pots	G2425.12, R1001.8, R1003.11.1, Table R1003.14.1
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C 425—04	Specification for Compression Joints for Vitrified Clay Pipe and Fittings	Table P3002.2, P3003.15, P3003.16
C 428—97 (2006)	Specification for Asbestos-cement Nonpressure Sewer Pipe	Table P3002.2
C 443—05a	Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets	P3003.7, P3003.14
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C 508—04	Specification for Asbestos-cement Underdrain Pipe	Table P3302.1
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C 552—03	Standard Specification for Cellular Glass Thermal Insulation	Table R906.2
C 557—03e01	Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing	R702.3.1
C 564—03a	Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings	P3003.6.2, P3003.6.3, P3003.14
C 578—07	Specification for Rigid, Cellular Polystyrene Thermal Insulation	R403.3, R613.3.1, R703.11.2.1, Table R906.2
C 587—04	Specification for Gypsum Veneer Plaster	R702.2.1
C 588/C 588M—01	Specification for Gypsum Base for Veneer Plasters	R702.2.1, R702.2.2
C 595—07	Specification for Blended Hydraulic Cements	R702.2.2
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C 645—07	Specification for Nonstructural Steel Framing Members	R702.3.3
C 652—05a	Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)	R202, Table R301.2.1
C 685—01	Specification for Concrete Made by Volumetric Batching and Continuous Mixing	R404.1.2.3.2, R611.5.1.1
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C 836—06	Specification for High Solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course	R905.15.2
C 843—99 (2006)	Specification for Application of Gypsum Veneer Plaster	R702.2.1
C 844—04	Specification for Application of Gypsum Base to Receive Gypsum Veneer Plaster	R702.2.1
C 847—06	Specification for Metal Lath	R702.2.1, R702.2.2
C 887—05	Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar	R406.1
C 897—05	Specification for Aggregate for Job-mixed Portland Cement-based Plasters	R702.2.2
C 920—05	Standard Specification for Elastomeric Joint Sealants	R406.4.1
C 926—98a (2005)	Specification for Application of Portland Cement-based Plaster	R702.2.2, R703.6, R703.6.2, R703.6.4
C 931/C 931M—04	Specification for Exterior Gypsum Soffit Board	R702.3.1
C 933—05	Specification for Welded Wire Lath	R702.2.1, R702.2.2
C 954—04	Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness	R505.2.4, R603.2.4, R702.3.6, R804.2.4
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C 1002—04	Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases	R702.3.1, R702.3.6
C 1029—05a	Specification for Spray-applied Rigid Cellular Polyurethane Thermal Insulation	R905.14.2
C 1032—06	Specification for Woven Wire Plaster Base	R702.2.1, R702.2.2
C 1047—05	Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base	R702.2.1, R702.2.2, R702.3.1
C 1063—06	Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-based Plaster	R702.2.2, R703.6
C 1107—07	Standard Specification for Packaged Dry, Hydraulic-cement Grout (Nonshrink)	R402.3.1
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C 1186—07	Specification for Flat Nonasbestos Fiber Cement Sheets	R703.10.1, R703.10.2
C 1261—07	Specification for Firebox Brick for Residential Fireplaces	R1001.5, R1001.8
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C 1278/C 1278M—06	Specification for Fiber-reinforced Gypsum Panels	R702.3.1, R702.3.8, R702.4.2
C 1283—07	Practice for Installing Clay Flue Lining	R1003.12
C 1288—99(2004)	Standard Specification for Discrete Nonasbestos Fiber-cement Interior Substrate Sheets	R702.4.2
C 1289—07	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board	R703.11.2.1, Table R906.2
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C 1461—06	Specification for Mechanical Couplings Using Thermoplastic Elastomeric (TPE) Gaskets for Joining Drain, Waste and Vent (DWV) Sewer, Sanitary and Storm Plumbing Systems for Above and Below Ground Use	P3003.18
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D 225—04	Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules	R905.2.4
D 226—06	Specification for Asphalt-saturated (Organic Felt) Used in Roofing and Waterproofing	R703.2, R905.2.3, R905.3.3, R905.4.3, R905.5.3, R905.6.3, R905.7.3, R905.8.3, R905.8.4, Table R905.9.2
D 227—03	Specification for Coal Tar Saturated (Organic Felt) Used in Roofing and Waterproofing	Table R905.9.2
D 312—00(2006)	Specification for Asphalt Used in Roofing	Table R905.9.2
D 422—63(2002)e01	Test Method for Particle-size Analysis of Soils	R403.1.8.1
D 449—03	Specification for Asphalt Used in Dampproofing and Waterproofing	R406.2
D 450—07	Specification for Coal-tar Pitch Used in Roofing, Dampproofing and Waterproofing	Table R905.9.2
D 1227—95(2007)	Specification for Emulsified Asphalt Used as a Protective Coating for Roofing	Table R905.9.2, Table R905.11.2, R905.15.2
D 1248—05	Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable	M1601.1.2
D 1527—99(2005)	Specification for Acrylonitrile-butadiene-styrene (ABS) Plastic Pipe, Schedules 40 and 80	Table P2905.4
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D 1622—03	Standard Test Method for Apparent Density of Rigid Cellular Plastics	Table R613.3.1
D 1623—78(1995)	Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics	Table R613.3.1
D 1693—07	Test Method for Environmental Stress-cracking of Ethylene Plastics	Table M2101.1
D 1784—06a	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds	M1601.1.2
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D 1863—05	Specification for Mineral Aggregate Used in Built-up Roofs	Table R905.9.2
D 1869—95(2005)	Specification for Rubber Rings for Asbestos-cement Pipe	P2904.17, P3003.4, P3003.18
D 1970—01	Specification for Self-adhering Polymer Modified Bitumen Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection	R905.2.3, R905.2.8, R905.4.3
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D 2178—04	Specification for Asphalt Glass Felt Used in Roofing and Waterproofing	Table R905.9.2
D 2235—04	Specification for Solvent Cement for Acrylonitrile-butadiene-styrene (ABS) Plastic Pipe and Fittings	P2905.9.1.1, P3003.3.2, P3003.8.2
D 2239—03	Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter	Table P2905.4
D 2241—05	Specification for Poly (Vinyl Chloride) (PVC) Pressure-rated Pipe (SDR-Series)	Table P2905.4
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D 2466—06	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40	Table P2905.6
D 2467—06	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80	Table P2905.6
D 2468—96a	Specification for Acrylonitrile-butadiene-styrene (ABS) Plastic Pipe Fittings, Schedule 40	Table P2905.6
D 2513—07a	Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings	G2414.6, G2414.6.1, G2414.1.1, G2415.15.2, Table M2101.1, M2104.2.1.3
D 2559—04	Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (West Use) Exposure Conditions	R613.3.3
D 2564—04e01	Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems	P2905.9.1.3, Table P3002.2, P3003.9.2, P3003.14.2
D 2609—02	Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe	Table P2905.6
D 2626—04	Specification for Asphalt-saturated and Coated Organic Felt Base Sheet Used in Roofing	R905.3.3, Table R905.9.2
D 2657—07	Standard Practice for Heat Fusion-joining of Polyolefin Pipe Fittings	P2905.3.1, P3003.17.1
D 2661—06	Specification for Acrylonitrile-butadiene-styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings	Table P3002.1(1), Table P3002.1(2), Table P3002.2, Table P3002.3, P3003.3.2, P3003.8.2
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D 2672—96a(2003)	Specification for Joints for IPS PVC Pipe Using Solvent Cement	Table P2905.4
D 2683—04	Specification for Socket-type Polyethylene Fittings for Outside Diameter-controlled Polyethylene Pipe and Tubing	Table M2101.1, M2104.2.1.1
D 2729—04e01	Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	P3302.1, Table P3302.1, Table AO103.10
D 2737—03	Specification for Polyethylene (PE) Plastic Tubing	Table P2905.4

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D 2824—06	Specification for Aluminum-pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered and Fibered without Asbestos	Table R905.9.2, Table R905.11.2
D 2837—04e01	Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products	Table M2101.1
D 2846/D 2846M—06	Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-water Distribution Systems	Table M2101.1, P2904.9.1.2, Table P2905.4, Table P2905.5, Table P2905.6
D 2855-96 (2002)	Standard Practice for Making Solvent-cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings	P3003.9.2, P3003.14.2
D 2898—04	Test Methods for Accelerated Weathering of Fire-retardant-treated Wood for Fire Testing	R802.1.3.4, R802.1.3.6
D 2949—01ae01	Specification for 3.25-in. Outside Diameter Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings	Table P3002.1(1), Table P3002.1(2), Table P3002.2, Table P3002.3
D 3019—94 (2007)	Specification for Lap Cement Used with Asphalt Roll Roofing, Nonfibered, Asbestos Fibered and Nonasbestos Fibered	Table R905.9.2, Table R905.11.2
D 3034—06	Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	Table P3002.2, Table P3002.3
D 3035—06	Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based On Controlled Outside Diameter	Table M2101.1
D 3161—06	Test Method for Wind Resistance of Asphalt Shingles (Fan Induced Method)	R905.2.4.1, Table R905.2.4.1(2)
D 3201—07	Test Method for Hygroscopic Properties of Fire-retardant Wood and Wood-base Products	R802.1.3.7
D 3212—96a (2003)e01	Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals	P3003.3.1 P3003.8.1, P3003.9.1, P3003.14.1, P3003.17.2
D 3309—96a (2002)	Specification for Polybutylene (PB) Plastic Hot- and Code-water Distribution System	Table M2101.1
D 3311—06a	Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patters	P3002.3
D 3350—06	Specification for Polyethylene Plastic Pipe and Fitting Materials	Table M2101.1
D 3462—07	Specification for Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules	R905.2.4
D 3468—99 (2006)e01	Specification for Liquid-applied Neoprene and Chlorosulfanated Polyethylene Used in Roofing and Waterproofing	R905.15.2
D 3679—06a	Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding	Table R703.4, R703.11
D 3737—07	Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)	R502.1.5, R602.1.2, R802.1.4
D 3747—79 (2007)	Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation	Table R905.9.2, Table R905.11.2
D 3909—97b (2004)e01	Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules	R905.2.8.2, R905.5.4, Table R905.9.2
D 3957—06	Standard Practices for Establishing Stress Grades for Structural Members Used in Log Buildings	R502.1.6, R602.1.3, R802.1.5
D 4022—07	Specification for Coal Tar Roof Cement, Asbestos Containing	Table R905.9.2
D 4068—01	Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water Containment Membrane	P2709.2, P2709.2.2
D 4318—05	Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils	R403.1.8.1
D 4434—06	Specification for Poly (Vinyl Chloride) Sheet Roofing	R905.13.2
D 4479—07	Specification for Asphalt Roof Coatings-asbestos-free	Table R905.9.2
D 4551—96 (2001)	Specification for Poly (Vinyl) Chloride (PVC) Plastic Flexible Concealed Water-containment Membrane	P2709.2, P2709.2.1
D 4586—00	Specification for Asphalt Roof Cement-asbestos-free	Table R905.9.2
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D 4637—04	Specification for EPDM Sheet Used in Single-ply Roof Membrane	R905.12.2
D 4829—07	Test Method for Expansion Index of Soils	R403.1.8.1
D 4869—05e01	Specification for Asphalt-saturated (Organic Felt) Underlayment Used in Steep Slope Roofing	R905.2.3, R905.4.3, R905.5.3, R905.6.3, R905.7.3, R905.8.3
D 4897—01	Specification for Asphalt Coated Glass-fiber Venting Base Sheet Used in Roofing	Table R905.9.2
D 4990—97a (2005)e01	Specification for Coal Tar Glass Felt Used in Roofing and Waterproofing	Table R905.9.2
D 5019—07	Specification for Reinforced Nonvulcanized Polymeric Sheet Used in Roofing Membrane	R905.12.2
D 5055—05	Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-joists	R502.1.4
D 5516—03	Test Method for Evaluating the Flexural Properties of Fire-retardant-treated Softwood Plywood Exposed to the Elevated Temperatures	R802.1.3.5.1
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D 5665—99a(2006)	Specification for Thermoplastic Fabrics Used in Cold-applied Roofing and Waterproofing	Table R905.9.2
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D 6083—05e01	Specification for Liquid-applied Acrylic Coating Used in Roofing	Table R905.9.2, Table R905.11.2, R905.15.2
D 6162—00a	Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements	Table R905.11.2
D 6163—00e01	Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements	Table R905.11.2
D 6164—05	Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements	Table R905.11.2
D 6222—02e01	Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcement	Table R905.11.2
D 6223—02e01	Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcement	Table R905.11.2
D 6298—05	Specification for Fiberglass-reinforced Styrene Butadiene Styrene (SBS) Modified Bituminous Sheets with a Factory Applied Metal Surface	Table R905.11.2
D 6305—02e01	Practice for Calculating Bending Strength Design Adjustment Factors for Fire-retardant-treated Plywood Roof Sheathing	R802.1.3.5.1
D 6380—03	Standard Specification for Asphalt Roll Roofing (Organic Felt)	R905.2.8.2, R905.3.3, R905.5.4
D 6694—07	Standard Specification Liquid-applied Silicone Coating Used in Spray Polyurethane Foam Roofing	R905.15.2
D 6754—02	Standard Specification for Ketone-ethylene-ester-based Sheet Roofing	R905.13.2
D 6757—07	Standard Specification for Inorganic Underlayment for Use with Steep Slope Roofing Products	R905.2.3
D 6841—03	Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire-retardant-treated Lumber	R802.1.3.5.2
D 6878—06a	Standard Specification for Thermoplastic-polyolefin-based Sheet Roofing	R905.13.2
D 6947—07	Standard Specification for Liquid Applied Moisture Cured Polyurethane Coating Used in Spray Polyurethane Foam Roofing System	R905.15.2
D 7032—07	Standard Specification for Establishing Performance Ratings for Wood-plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails)	R317.4
D 7158—07	Standard Test Method for Wind Resistance of Sealed Asphalt Shingles (Uplift Force/Uplift Resistance Method)	R905.2.4.1, Table R905.2.4.1(1)
E 84—07	Test Method for Surface Burning Characteristics of Building Materials	M1601.3, M1601.5.2, R202, R302.9.3, R302.9.4, R302.10.1, R302.10.2, R316.3, R316.5.9, R316.5.11, R802.1.3
E 90—04	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements	AK102, AK102.1.1
E 96/E 96M—05	Test Method for Water Vapor Transmission of Materials	M1411.5, M1601.4.5, R202, Table R613.3.1
E 108—07a	Test Methods for Fire Tests of Roof Coverings	R902.1
E 119—07	Test Methods for Fire Tests of Building Construction and Materials	Table R302.1, R302.2, R302.3, R302.4.1, R316.4
E 136—04	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C	R202, R302.11
E 283—04	Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen	N1102.4.5
E 330—02	Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference	R612.7, R612.8, R703.1.2
E 331—00	Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference	R703.1.1
E 492—04	Specification for Laboratory Measurement of Impact Sound Transmission through Floor-ceiling Assemblies Using the Tapping Machine	AK103
E 814—06	Test Method for Fire Tests of Through-penetration Firestops	R302.4.1.2
E 970—00	Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source	R302.10.5
E 1509—04	Standard Specification for Room Heaters, Pellet Fuel-burning Type	M1410.1
E 1602—03	Guide for Construction of Solid Fuel Burning Masonry Heaters	R1002.2
E 1886—06	Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials	R301.2.1.2, R612.9.1
E 1996—06	Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes	R301.2.1.2, R612.9.1
E 2178—03	Standard Test Method for Air Permeance of Building Materials	R202
E 2231—04	Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics	M1601.3
E 2273—03	Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies	R703.9.2
E 2568—07	Standard Specification for PB Exterior Insulation and Finish Systems (EIFS)	R703.9.1, R703.9.2

ASTM—continued

E 2570—07	Standard Test Methods for Evaluating Water-resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage	R703.9.2.1
F 405—05	Specification for Corrugated Polyethylene (PE) Tubing and Fittings	Table P3302.1, Table AO103.10
F 409—02	Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings	Table P2701.1, P2702.2, P2702.3
F 437—06	Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Table P2905.6
F 438—04	Specification for Socket-type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40	Table P2905.6
F 439—06	Specification for Socket-type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	Table P2905.6
F 441/F 441M—02	Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80	Table P2905.4, Table P2905.5
F 442/F 442M—99(2005)	Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)	Table P2905.4, Table P2905.5
F 477—07	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe	P2905.17, P3003.18
F 493—04	Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings	P2905.9.1.2
F 628—06e1	Specification for Acrylonitrile-butadiene-styrene (ABS) Schedule 40 Plastic Drain, Waste and Vent Pipe with a Cellular Core	Table P3002.1(1), Table P3002.1(2), Table P3002.2, Table P3002.3, P3003.3.2, P3003.8.2
F 656—02	Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings	P2905.9.1.3, P3003.9.2, P3003.14.2
F 714—06a	Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter	Table P3002.2
F 876—06	Specification for Cross-linked Polyethylene (PEX) Tubing	Table M2101.1, Table P2905.4, Table P2905.5
F 877—07	Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-water Distribution Systems	Table M2101.1, Table P2905.4, Table P2905.5, Table P2905.6
F 891—04	Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core	P2905.6, Table P3002.1(1), Table P3002.1(2), Table P3002.2, Table P3302.1
F 1055—98(2006)	Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Fittings	Table M2101.1, M2104.2.1.2
F 1281—07	Specification for Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Pressure Pipe	Table M2101.1, Table P2905.4, Table P2905.5, Table P2905.6, P2905.11.1
F 1282—06	Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe	Table M2101.1, Table P2905.4, Table P2905.5, Table P2905.6, P2905.11.1
F 1346—91(2003)	Performance Specification for Safety Covers and Labeling Requirements for All Covers for Swimming Pools, Spas and Hot Tubs	AG105.2, AG105.5
F 1412—01e01	Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage	Table P3002.1(2), Table P3002.2, Table P3002.3, P3003.16.1
F 1488—03	Specification for Coextruded Composite Pipe	Table P3002.1(1), Table P3002.1(2) Table P3002.2, Table AO103.10
F 1554—04e1	Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength	R611.5.2.2
F 1667—05	Specification for Driven Fasteners, Nails, Spikes and Staples	Table R703.4, R905.2.5
F 1807—07	Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing	Table M2101.1, Table P2905.6
F 1866—07	Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings	Table P3002.3
F 1960—07	Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing	Table M2101.1, Table P2905.6
F 1973—05	Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA 11) Fuel Gas Distribution Systems	G2415.15.2
F 1974—04	Specification for Metal Insert Fittings for Polyethylene/Aluminum/Polyethylene and Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene Composite Pressure Pipe	P2505.11.1, Table P2905.6
F 1986—01(2006)	Multilayer Pipe Type 2, Compression Joints for Hot and Cold Drinking Water Systems	Table P2905.4, Table P2905.5, Table P2905.6
F 2080—05	Specification for Cold-expansion Fittings with Metal Compression-sleeves for Cross-linked Polyethylene (PEX) Pipe	P2905.6
F 2090—01A(2007)	Specification for Window Fall Prevention Devices—with Emergency Escape (Egress) Release Mechanisms	R612.2, R612.3
F 2098—04e1	Standard Specification for Stainless Steel Clamps for SDR9 PEX Tubing to Metal Insert Fittings	Table M2101.1, Table P2905.6

# REFERENCED STANDARDS

## ASTM—continued

F 2159—05	Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing .....	P2905.6
F 2262—05	Standard Specification for Cross-linked Polyethylene /Aluminum/Cross-linked Polyethylene Tubing OD Controlled SDR9 .....	Table P2905.4, Table P2905.5
F 2389—06	Standard for Pressure-rated Polypropylene (PP) Piping Systems .....	Table M2101.1, Table P2905.4, Table P2905.5, Table P2905.6, P2905.10.1
F 2434—05	Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing .....	Table P2905.6
F 2623—07	Standard Specification for Polyethylene of Raised Temperature (PE-RT) SDRG Tubing .....	Table M2101.1

## AWPA

American Wood Protection Association  
P.O. Box 361784  
Birmingham, AL 35236-1784

Standard reference number	Title	Referenced in code section number
C1—03	All Timber Products—Preservative Treatment by Pressure Processes .....	R902.2
M4—06	Standard for the Care of Preservative-treated Wood Products .....	R317.1.1, R318.1.2
U1—07	USE CATEGORY SYSTEM: User Specification for Treated Wood Except Section 6 Commodity Specification H .....	R317.1, R322.1.8, R402.1.2, R504.3, Table R905.8.5

## AWS

American Welding Society  
550 N. W. LeJeune Road  
Miami, FL 33126

Standard reference number	Title	Referenced in code section number
A5.8—04	Specifications for Filler Metals for Brazing and Braze Welding .....	P3003.5.1, P3003.10.1, P3003.11.1

## AWWA

American Water Works Association  
6666 West Quincy Avenue  
Denver, CO 80235

Standard reference number	Title	Referenced in code section number
C104—98	Standard for Cement-mortar Lining for Ductile-iron Pipe and Fittings for Water .....	P2905.4
C110/A21.10—03	Standard for Ductile-iron and Gray-iron Fittings, 3 Inches through 48 Inches, for Water .....	Table P2905.6, Table P3002.3
C115/A21.15—99	Standard for Flanged Ductile-iron Pipe with Ductile-iron or Gray-iron Threaded Flanges .....	Table P2905.4
C151/A21.51—02	Standard for Ductile-iron Pipe, Centrifugally Cast, for Water .....	Table P2905.4
C153/A21.53—00	Standard for Ductile-iron Compact Fittings for Water Service .....	Table P2905.6
C510—00	Double Check Valve Backflow Prevention Assembly .....	Table P2902.3, P2902.3.6
C511—00	Reduced-pressure Principle Backflow Prevention Assembly .....	Table P2902.3, P2902.3.5, P2902.5.1

## CGSB

Canadian General Standards Board  
Place du Portage 111, 6B1  
11 Laurier Street  
Gatineau, Quebec, Canada KIA 1G6

Standard reference number	Title	Referenced in code section number
37-GP—52M—(1984)	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric .....	R905.12.2
37-GP—56M—(1980)	Membrane, Modified Bituminous, Prefabricated and Reinforced for Roofing —with December 1985 Amendment .....	Table R905.11.2
CAN/CGSB-37.54—95	Polyvinyl Chloride Roofing and Waterproofing Membrane .....	R905.13.2



## Part I—Administrative

### CHAPTER 1

## SCOPE AND ADMINISTRATION

### PART I—SCOPE AND APPLICATION

#### SECTION R101 GENERAL

**R101.1 Title.** These provisions shall be known and cited as the Michigan residential code for 1- and 2-family dwellings and will be referred to as “the code.”

R 408.30501

**R101.2 Scope.** The provisions of the *International Residential Code for One- and Two-family Dwellings* shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal and demolition of detached one- and two-family dwellings and townhouses not more than three stories above *grade plane* in height with a separate means of egress and their *accessory structures*.

**Exception:** Live/work units complying with the requirements of Section 419 of the *International Building Code* shall be permitted to be built as one- and two-family dwellings or townhouses. Fire suppression required by Section 419.5 of the *International Building Code* when constructed under the *International Residential Code for One- and Two-family Dwellings* shall conform to Section 903.3.1.3 of the *International Building Code*.

**R101.3 Intent.** The purpose of this code is to establish minimum requirements to safeguard the public safety, health and general welfare through affordability, structural strength, means of egress facilities, stability, sanitation, light and ventilation, energy conservation and safety to life and property from fire and other hazards attributed to the built environment and to provide safety to fire fighters and emergency responders during emergency operations.

#### SECTION R102 APPLICABILITY

**R102.1 General.** Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

**R102.2 Other laws.** The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

**R102.3 Application of references.** References to chapter or section numbers, or to provisions not specifically identified by

number, shall be construed to refer to such chapter, section or provision of this code.

**R102.4 Referenced codes and standards.** The codes and standards referenced in this code shall be considered part of the requirements of this code to the prescribed extent of each such reference. Where differences occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

**Exception:** Where enforcement of a code provision would violate the conditions of the *listing* of the *equipment* or *appliance*, the conditions of the *listing* and manufacturer's instructions shall apply.

**R102.5 Appendices.** Provisions in the appendices shall not apply unless specifically referenced in the adopting ordinance.

**R102.6 Partial invalidity.** In the event any part or provision of this code is held to be illegal or void, this shall not have the effect of making void or illegal any of the other parts or provisions.

**R102.7 Existing structures.** The legal occupancy of any structure existing on the date of adoption of this code shall be permitted to continue without change, except as is specifically covered in this code, the *International Property Maintenance Code* or the *International Fire Code*, or as is deemed necessary by the *building official* for the general safety and welfare of the occupants and the public.

**R102.7.1 Additions, alterations or repairs.** *Additions, alterations* or repairs to any structure shall conform to the requirements for a new structure without requiring the existing structure to comply with all of the requirements of this code, unless otherwise stated. *Additions, alterations* or repairs shall not cause an existing structure to become unsafe or adversely affect the performance of the building.

### PART II—ADMINISTRATION AND ENFORCEMENT

#### SECTION R103 DEPARTMENT OF BUILDING SAFETY

**R103.1 Creation of enforcement agency.** The department of building safety is hereby created and the official in charge thereof shall be known as the *building official*.

## SCOPE AND ADMINISTRATION

tures moved into or within the jurisdiction shall comply with the provisions of this code for new installations.

**102.8 Referenced codes and standards.** The codes and standards referenced in this code shall be those that are listed in Chapter 14 and such codes and standards shall be considered as part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections 102.8.1 and 102.8.2.

**102.8.1 Conflicts.** Where conflicts occur between provisions of this code and the referenced standards, the provisions of this code shall apply.

**102.8.2 Provisions in referenced codes and standards.** Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

**102.9 Requirements not covered by code.** Any requirements necessary for the strength, stability or proper operation of an existing or proposed plumbing system, or for the public safety, health and general welfare, not specifically covered by this code shall be determined by the code official.

\*

## PART 2—ADMINISTRATION AND ENFORCEMENT

## SECTION 103

## DEPARTMENT OF PLUMBING INSPECTION

**103.1 General.** The department of plumbing inspection is hereby created and the executive official in charge thereof shall be known as the code official.

**103.2 Appointment.** The code official shall be appointed by the chief appointing authority of the jurisdiction.

**103.3 Deputies.** In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the code official shall have the authority to appoint a deputy code official, other related technical officers, inspectors and other employees. Such employees shall have powers as delegated by the code official.

\*

## SECTION 104

## DUTIES AND POWERS OF THE CODE OFFICIAL

**104.1 General.** The code official shall enforce all of the provisions of the code and shall act on any question relative to the installation, alteration, repair, maintenance, or operation of all plumbing systems, devices, and equipment except as specifically provided for by statutory requirements or as provided for in sections 104.3 to 104.7.

R 408.30717

**104.2 Applications and permits.** The code official shall receive applications, review construction documents and issue permits for the installation and alteration of plumbing systems, inspect the premises for which such permits have

been issued, and enforce compliance with the provisions of this code.

**104.3 Inspections.** The code official shall make all the required inspections, or shall accept reports of inspection by *approved* agencies or individuals. All reports of such inspections shall be in writing and be certified by a responsible officer of such *approved* agency or by the responsible individual. The code official is authorized to engage such expert opinion as deemed necessary to report on unusual technical issues that arise, subject to the approval of the appointing authority.

**104.4 Right of entry.** Whenever it is necessary to make an inspection to enforce the provisions of this code, or whenever the code official has reasonable cause to believe that there exists in any building or upon any premises any conditions or violations of this code that make the building or premises unsafe, insanitary, dangerous or hazardous, the code official shall have the authority to enter the building or premises at all reasonable times to inspect or to perform the duties imposed upon the code official by this code. If such building or premises is occupied, the code official shall present credentials to the occupant and request entry. If such building or premises is unoccupied, the code official shall first make a reasonable effort to locate the owner or other person having charge or control of the building or premises and request entry. If entry is refused, the code official shall have recourse to every remedy provided by law to secure entry.

When the code official shall have first obtained a proper inspection warrant or other remedy provided by law to secure entry, no owner or occupant or person having charge, care or control of any building or premises shall fail or neglect, after proper request is made as herein provided, to promptly permit entry therein by the code official for the purpose of inspection and examination pursuant to this code.

**104.5 Identification.** The code official shall carry proper identification when inspecting structures or premises in the performance of duties under this code.

**104.6 Notices and orders.** The code official shall issue all necessary notices or orders to ensure compliance with this code.

**104.7 Department records.** The code official shall keep official records of applications received, permits and certificates issued, fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records for the period required for the retention of public records.

SECTION 105  
APPROVAL

**105.1 Modifications.** Whenever there are practical difficulties involved in carrying out the provisions of this code, the code official shall have the authority to grant modifications for individual cases, upon application of the owner or owner's representative, provided the code official shall first find that special individual reason makes the strict letter of this code impractical and the modification conforms to the intent and purpose of this code and that such modification



State of Michigan  
John Engler, Governor

Department of Consumer & Industry Services  
Kathleen M. Wilbur, Director

Attachment 3  
Page 1 of 9

Bureau of Construction Codes  
P.O. Box 30254  
Lansing, Michigan 48909

Administration Division  
517/241-9302

March 7, 2001

Mr. Jerry D'Hulster  
Perma-Liner Inc.  
18548 U.S. Highway 19 North  
Clearwater, Florida 33764

Dear Mr. D'Hulster:

At the Construction Code Commission meeting on March 7, 2001, the Plumbing Division presented your request for approval of the Perma-Lateral Lining System.

The Construction Code Commission, upon recommendation of the State Plumbing Board, approved the use of the Perma-Lateral Lining System with the following conditions:

1. All requirements of the Michigan Plumbing code shall be applicable.
2. Installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and after the installation of the liner.
4. Testing in accordance with the code shall be accomplished to assure the system is free from exfiltration.

Should any change be made in the design or designation of this product the modified product must be submitted to this office, and a new acceptance obtained.

In accordance with Section 21 of Act 230 of the Public Acts of 1972, as amended, neither this letter nor the Certificate of Acceptability may be used for advertising or promotional purposes.

A Certificate of Acceptability is enclosed.

Sincerely,



Henry L. Green  
Executive Director

HLG/sb  
Enclosure

cc: Duane Branch



MICHIGAN DEPARTMENT OF CONSUMER & INDUSTRY SERVICES  
BUREAU OF CONSTRUCTION CODES  
P.O. BOX 30254  
LANSING, MI 48909

**CERTIFICATE OF ACCEPTABILITY**  
**PRODUCT APPROVAL**

No. 1496 PA

Issued by the Michigan State Construction Code Commission in accordance with authority granted under Section 21, Act 230 of Public Acts of 1972, as amended, being Section 125.1521 of the Michigan Compiled Laws; on the recommendation of the State Plumbing Board.

**MANUFACTURER:** Perma-Liner Inc.  
18548 U.S. Highway 19 North  
Clearwater, Florida 33764

**PRODUCT:** Perma-Lateral Lining System

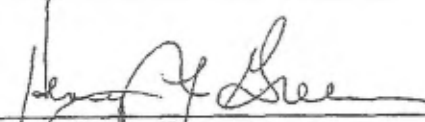
**MANUFACTURER'S DESIGNATION:** Perma-Lateral Lining System

**CONDITIONS OF USE AND INSTALLATION:**

1. All requirements of the Michigan Plumbing code shall be applicable.
2. Installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and after the installation of the liner.
4. Testing in accordance with the code shall be accomplished to assure the system is free from exfiltration.

**THIS CERTIFICATE SHALL NOT BE USED FOR ADVERTISING PURPOSES.**

By Direction of the Construction Code Commission

  
Henry L. Green, Executive Director

  
Robert G. Konyndyk, Chief, Plumbing Division

Effective Date: March 7, 2001



STATE OF MICHIGAN

JENNIFER M. GRANHOLM  
GOVERNOR

DEPARTMENT OF LABOR & ECONOMIC GROWTH  
LANSING

DAVID C. HOLLISTER  
DIRECTOR

January 25, 2006

Mr. Robert Richards  
Nu Flow Technologies 2000 Inc.  
1010 Thornton Road South  
Oshawa, Ontario L1J7E2

Dear Mr. Richards:

At the Construction Code Commission meeting on January 11, 2006, the Plumbing Division presented your request for approval of the Nu Flow Lateral Lining, Cured In Place Pipe (CIPP).

The Construction Code Commission, upon recommendation of the State Plumbing Board, approved the use of the Nu Flow Lateral Lining, Cured In Place Pipe (CIPP) with the following conditions:

1. All requirements of the Michigan Plumbing Code shall be applicable.
2. Installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and following the installation of the liner after testing.
4. Testing in accordance with the code shall be accomplished to assure the system is free from infiltration.

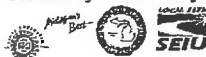
Should any change be made in the design or designation of these products the modified products must be submitted to this office, and a new acceptance obtained.

In accordance with Section 21 of Act 230 of the Public Acts of 1972, as amended, neither this letter nor the Certificate of Acceptability may be used for advertising or promotional purposes.

BUREAU OF CONSTRUCTION CODES & FIRE SAFETY  
P.O. BOX 30254 • LANSING, MICHIGAN 48909 • (517) 241-9330 • FAX (517) 241-9308

[www.michigan.gov](http://www.michigan.gov)

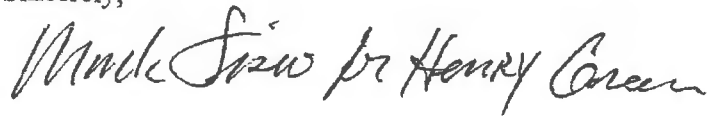
Printed by members of:



Mr. Robert Richards  
Page 2  
January 25, 2006

A Certificate of Acceptability is enclosed.

Sincerely,

A handwritten signature in cursive script that reads "Mark Sizemore for Henry Green". The signature is written in dark ink and is positioned above the typed name of the signatory.

Henry L. Green  
Executive Director

HLG/mkr  
Enclosure

cc: Duane Branch



**CERTIFICATE OF ACCEPTABILITY**

NO. 1549 PA

Issued by the Michigan State Construction Code Commission in accordance with authority granted under Section 21, Act 230 of Public Acts of 1972, as amended, being Section 125.1521 of the Michigan Compiled Laws' on the recommendation of the State Plumbing Board.

**MANUFACTURER:** Nu Flow Technologies 2000 Inc.  
1010 Thornton Road South  
Oshawa, Ontario L1J7E2

**PRODUCT:** Nu Flow Lateral Lining, Cured In Place Pipe (CIPP).

**CONDITIONS OF USE AND INSTALLATION:**

1. All requirements of the Michigan Plumbing Code shall be applicable.
2. Installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and following the installation of the liner after testing.
4. Testing in accordance with the code shall be accomplished to assure the system is free from infiltration.

**THIS CERTIFICATE SHALL NOT BE USED FOR ADVERTISING PURPOSES.**

By Direction of the Construction Code Commission

  
Henry L. Green, Executive Director

  
Robert G. Konyndyk, Chief, Plumbing Division

Effective Date: January 11, 2006



Attachment 3  
Page 6 of 9

JOHN ENGLER  
GOVERNOR

STATE OF MICHIGAN  
DEPARTMENT OF CONSUMER & INDUSTRY SERVICES  
LANSING

XXXXXXXXXXXXX  
KATHLEEN WILBUR  
DIRECTOR  
Noelle A. Clark  
Director

September 18, 2002

Mr. Tommy Wright  
Applied Felts, Inc.  
450 College Drive  
Martinsville, VA 24112

Dear Mr. Wright:

At the Construction Code Commission meeting on September 11, 2002, the Plumbing Division presented your request for approval of the MaxLiner Lateral Lining System.

The Construction Code Commission, upon recommendation of the State Plumbing Board, approved the use of the MaxLiner Lateral Lining System with the following conditions:

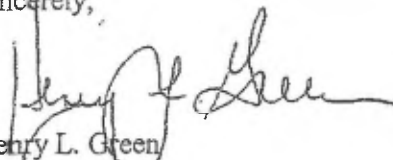
1. All requirements of the Michigan Plumbing Code shall be applicable.
2. Shall be installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and following the installation of the liner after testing.
4. Testing in accordance with the code shall be accomplished to assure the system is free from exfiltration.

Should any change be made in the design or designation of this product, the modified product must be submitted to this office, and a new acceptance obtained.

In accordance with Section 21 of Act 230 of the Public Acts of 1972, as amended, neither this letter nor the Certificate of Acceptability may be used for advertising or promotional purposes.

A Certificate of Acceptability is enclosed.

Sincerely,



Henry L. Green  
Executive Director

HLG/sb  
Enclosure

cc: Duane Branch

MICHIGAN DEPARTMENT OF CONSUMER & INDUSTRY SERVICES  
BUREAU OF CONSTRUCTION CODES  
P.O. BOX 30254  
LANSING, MI 48909

**CERTIFICATE OF ACCEPTABILITY**  
**PRODUCT APPROVAL**

No. 1515-PA

Issued by the Michigan State Construction Code Commission in accordance with authority granted under Section 21, Act 230 of Public Acts of 1972, as amended, being Section 125.1521 of the Michigan Compiled Laws; on the recommendation of the State Plumbing Board.

**MANUFACTURER:** Applied Felts, Inc.  
450 College Drive  
Martinsville, VA 24112

**PRODUCT:** MaxLiner Lateral Lining System

**MANUFACTURER'S DESIGNATION:** MaxLiner Lateral Lining System

**CONDITIONS OF USE AND INSTALLATION:**

1. All requirements of the Michigan Plumbing Code shall be applicable.
2. Shall be installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and following the installation of the liner after testing.
4. Testing in accordance with the code shall be accomplished to assure the system is free from exfiltration.

**THIS CERTIFICATE SHALL NOT BE USED FOR ADVERTISING PURPOSES.**

By Direction of the Construction Code Commission

  
Henry L. Green, Executive Director

  
Robert G. Konyndyk, Chief, Plumbing Division

Effective Date: September 11, 2002



JENNIFER M. GRANHOLM  
GOVERNOR

STATE OF MICHIGAN  
DEPARTMENT OF CONSUMER & INDUSTRY SERVICES  
LANSING

DAVID C. HOLLISTER  
DIRECTOR

March 27, 2003

Mr. Gerald Marc-Aurele  
FORMADRAIN Inc.  
7551 Metropolitan Blvd.  
Montreal, Quebec H1J 1J8

Dear Mr. Marc-Aurele:

At the Construction Code Commission meeting on March 5, 2003, the Plumbing Division presented your request for approval of the FORMADRAIN Lateral Lining System.

The Construction Code Commission, upon recommendation of the State Plumbing Board, approved the use of the FORMADRAIN Lateral Lining System with the following conditions:

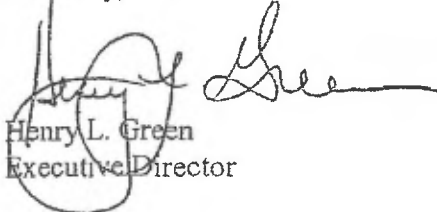
1. All requirements of the Michigan Plumbing Code shall be applicable.
2. Installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and following the installation of the line after testing.
4. Testing in accordance with the code shall be accomplished to assure the system is free from exfiltration.

Should any change be made in the design or designation of this product, the modified product must be submitted to this office, and a new acceptance obtained.

In accordance with Section 21 of Act 230 of the Public Acts of 1972, as amended, neither this letter nor the Certificate of Acceptability may be used for advertising or promotional purposes.

A Certificate of Acceptability is enclosed.

Sincerely,



Henry L. Green  
Executive Director

HLG/sb  
Enclosure



MICHIGAN DEPARTMENT OF CONSUMER & INDUSTRY SERVICES  
BUREAU OF CONSTRUCTION CODES  
P.O. BOX 30254  
LANSING, MI 48909

**CERTIFICATE OF ACCEPTABILITY**  
**PRODUCT APPROVAL**

No. 1517-PA

Issued by the Michigan State Construction Code Commission in accordance with authority granted under Section 21, Act 230 of Public Acts of 1972, as amended, being Section 125.1521 of the Michigan Compiled Laws; on the recommendation of the State Plumbing Board.

**MANUFACTURER:** FORMADRAIN Inc.  
7551 Metropolitan Blvd. East  
Montreal, Quebec H1J 1J8

**PRODUCT:** FORMADRAIN Lateral Lining System

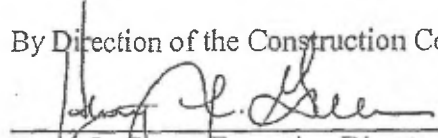
**MANUFACTURER'S DESIGNATION:** FORMADRAIN Lateral Lining System

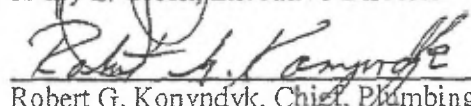
**CONDITIONS OF USE AND INSTALLATION:**

1. All requirements of the Michigan Plumbing Code shall be applicable.
2. Installed in accordance with manufacturer's installation instructions.
3. Visual closed circuit television shall be provided following cleaning of the line and following the installation of the liner after testing.
4. Testing in accordance with the code shall be accomplished to assure the system is free from exfiltration.

**THIS CERTIFICATE SHALL NOT BE USED FOR ADVERTISING PURPOSES.**

By Direction of the Construction Code Commission

  
Henry L. Green, Executive Director

  
Robert G. Konyndyk, Chief, Plumbing Division

Effective Date: March 5, 2003



JENNIFER M. GRANHOLM  
GOVERNOR

STATE OF MICHIGAN  
DEPARTMENT OF LABOR & ECONOMIC GROWTH  
LANSING

KEITH W. COOLEY  
DIRECTOR

May 15, 2008

Mr. Peter J. Wood  
American Pipe Lining – Great Lakes Inc.  
31675 W. Eight Mile Rd.  
Livonia, MI 48152

Dear Mr. Wood:

At the Construction Code Commission meeting on May 7, 2008, the Plumbing Division presented your request for approval of the APL-2000 Epoxy Pipe Coating Material.

The Construction Code Commission, upon recommendation of the State Plumbing Board, approved the use of the APL-2000 Epoxy Pipe Coating Material with the following conditions:

1. All requirements of the Michigan Plumbing code shall be applicable.
2. Installations shall be in accordance with manufacturer's specifications.

Should any change be made in the design or designation of these products the modified products must be submitted to this office, and a new acceptance obtained.

In accordance with Section 21 of Act 230 of the Public Acts of 1972, as amended, neither this letter nor the Certificate of Acceptability may be used for advertising or promotional purposes.

A Certificate of Acceptability is enclosed.

Sincerely,

A handwritten signature in cursive script that reads "Henry L. Green".

Henry L. Green, Hon. AIA  
Executive Director

HLG/mkr

Enclosure

cc: Duane Branch

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*Providing for Michigan's Safety in the Built Environment*

BUREAU OF CONSTRUCTION CODES  
P.O. BOX 30254 • LANSING, MICHIGAN 48909  
Telephone (517) 241-9330 • Fax (517) 373-8547  
[www.michigan.gov/dleg](http://www.michigan.gov/dleg)

**CERTIFICATE OF ACCEPTABILITY**

**NO. 1584 PA**

Issued by the Michigan State Construction Code Commission in accordance with authority granted under Section 21, Act 230 of Public Acts of 1972, as amended, being Section 125.1521 of the Michigan Compiled Laws' on the recommendation of the State Plumbing Board.

**MANUFACTURER:** American Pipe Lining – Great Lakes Inc.  
31675 W. Eight Mile Rd.  
Livonia, MI 48152

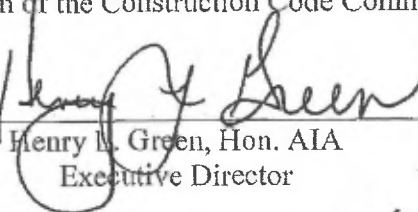
**PRODUCT:** APL-2000 Epoxy Pipe Coating Material

**CONDITIONS OF USE AND INSTALLATION:**

1. All requirements of the Michigan Plumbing code shall be applicable.
2. Installations shall be in accordance with manufacturer's specifications.

**THIS CERTIFICATE SHALL NOT BE USED FOR ADVERTISING PURPOSES.**

By Direction of the Construction Code Commission

  
Henry L. Green, Hon. AIA  
Executive Director

  
Robert G. Konyndyk, Chief, Plumbing Division

Effective Date: May 7, 2008

does not lessen health, life and fire safety requirements. The details of action granting modifications shall be recorded and entered in the files of the plumbing inspection department.

**105.2 Alternative materials, methods and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material or method of construction shall be *approved* where the code official finds that the proposed alternative material, method or equipment complies with the intent of the provisions of this code and is at least the equivalent of that prescribed in this code.

**105.2.1 Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

**105.3 Required testing.** Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternate materials or methods, the code official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction.

**105.3.1 Test methods.** Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the code official shall approve the testing procedures.

**105.3.2 Testing agency.** All tests shall be performed by an *approved* agency.

**105.3.3 Test reports.** Reports of tests shall be retained by the code official for the period required for retention of public records.

**105.4 Approved materials and equipment.** Materials, equipment and devices *approved* by the code official shall be constructed and installed in accordance with such approval.

**105.4.1 Material and equipment reuse.** Materials, equipment and devices shall not be reused unless such elements have been reconditioned, tested, placed in good and proper working condition and *approved*.

## SECTION 106 PERMITS

**106.1 When required.** Any owner, authorized agent or contractor who desires to construct, enlarge, alter, repair, move, demolish or change the *occupancy* of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any plumbing system, the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the code official and obtain the required permit for the work.

**106.2 Exempt work.** The following work shall be exempt from the requirement for a permit:

1. The stopping of leaks in drains, water, soil, waste or vent pipe provided, however, that if any concealed trap, drainpipe, water, soil, waste or vent pipe becomes defective and it becomes necessary to remove and replace the same with new material, such work shall be considered as new work and a permit shall be obtained and inspection made as provided in this code.
2. The clearing of stoppages or the repairing of leaks in pipes, valves or fixtures, and the removal and reinstallation of water closets, provided such repairs do not involve or require the replacement or rearrangement of valves, pipes or fixtures.

Exemption from the permit requirements of this code shall not be deemed to grant authorization for any work to be done in violation of the provisions of this code or any other laws or ordinances of this jurisdiction.

**106.3 Application for permit.** Each application for a permit, with the required fee, shall be filed with the code official on a form furnished for that purpose and shall contain a general description of the proposed work and its location. The application shall be signed by the owner or an authorized agent. The permit application shall indicate the proposed *occupancy* of all parts of the building and of that portion of the site or lot, if any, not covered by the building or structure and shall contain such other information required by the code official.

**106.3.1 Construction documents.** Construction documents, engineering calculations, diagrams and other such data shall be submitted in two or more sets with each application for a permit. The code official shall require construction documents, computations and specifications to be prepared and designed by a registered design professional when required by state law. Construction documents shall be drawn to scale and shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that the work conforms to the provisions of this code. Construction documents for buildings more than two stories in height shall indicate where penetrations will be made for pipes, fittings and components and shall indicate the materials and methods for maintaining required structural safety, fire-resistance rating and fireblocking.

**Exception:** The code official shall have the authority to waive the submission of construction documents, calculations or other data if the nature of the work applied for is such that reviewing of construction documents is not necessary to determine compliance with this code.

**106.3.2 Preliminary inspection.** Before a permit is issued, the code official is authorized to inspect and evaluate the systems, equipment, buildings, devices, premises and spaces or areas to be used.

**106.3.3 Time limitation of application.** An application for a permit for any proposed work shall be deemed to



## SECTION R104 DUTIES AND POWERS OF THE BUILDING OFFICIAL

**R104.1 General.** The *building official* is hereby authorized and directed to enforce the provisions of this code. The *building official* shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in conformance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.

**R104.2 Applications and permits.** The *building official* shall receive applications, review *construction documents* and issue permits for the erection and alteration of buildings and structures, inspect the premises for which such permits have been issued and enforce compliance with the provisions of this code.

**R104.3 Notices and orders.** The *building official* shall issue all necessary notices or orders to ensure compliance with this code.

**R104.4 Inspections.** The *building official* is authorized to make all of the required inspections, or the *building official* shall have the authority to accept reports of inspection by *approved agencies* or individuals. Reports of such inspections shall be in writing and be certified by a responsible officer of such *approved agency* or by the responsible individual. The *building official* is authorized to engage such expert opinion as deemed necessary to report upon unusual technical issues that arise, subject to the approval of the appointing authority.

**R104.5 Identification.** The *building official* shall carry proper identification when inspecting structures or premises in the performance of duties under this code.

**R104.6 Right of entry.** In the discharge of duties, the code official may enter any building, structure, or premises in the jurisdiction to enforce the provisions of the act and the code.

R 408.30504

**R104.7 Department records.** The *building official* shall keep official records of applications received, permits and certificates issued, fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records for the period required for the retention of public records.

**R104.9 Approved materials and equipment.** Materials, equipment, and devices shall be constructed or installed in accordance with approvals granted under the act or by the building official. The building official shall review reports prepared by recognized evaluation services and determine if the intent of the code is met.

R 408.30503

**R104.9.1 Used materials and equipment.** Used materials, equipment and devices shall not be reused unless *approved* by the *building official*.

**R104.10 Modifications.** Wherever there are practical difficulties involved in carrying out the provisions of this code, the *building official* shall have the authority to grant modifications for individual cases, provided the *building official* shall first

find that special individual reason makes the strict letter of this code impractical and the modification is in compliance with the intent and purpose of this code and that such modification does not lessen health, life and fire safety or structural requirements. The details of action granting modifications shall be recorded and entered in the files of the department of building safety.

**R104.10.1 Areas prone to flooding.** The *building official* shall not grant modifications to any provision related to areas prone to flooding as established by Table R301.2(1) without the granting of a variance to such provisions by the board of appeals.

**R104.11 Alternative materials, design, and methods of construction and equipment.** The provisions of the code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by the code, if the alternative has been approved. An alternative material, design, or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of the code, and that the material, method, or work offered is, for the purpose intended, at least the equivalent of that prescribed in the code. Compliance with the specific performance-based provisions of the Michigan building, R 408.30401 to R 408.30547, electrical, R 408.30801 to R 408.30880, mechanical, R 408.30901 to R 408.30998, and plumbing, R 408.30701 to R 408.30796, codes instead of specific requirements of the code shall also be permitted as an alternate.

R 408.30504

**R104.11.1 Tests.** Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the *building official* shall have the authority to require tests as evidence of compliance to be made at no expense to the *jurisdiction*. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the *building official* shall approve the testing procedures. Tests shall be performed by an *approved agency*. Reports of such tests shall be retained by the *building official* for the period required for retention of public records.

## SECTION R105 PERMITS

**R105.1 Required.** Any owner or authorized agent who intends to construct, enlarge, alter, repair, move, demolish or change the occupancy of a building or structure, or to erect, install, enlarge, alter, repair, remove, convert or replace any electrical, gas, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the *building official* and obtain the required permit.

**R105.2 Work exempt from permit.** Exemption from the permit requirements of the code shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of the code or any other laws or ordi-

Attachment #5  
2 of 2

nances of this jurisdiction. Permits are not required for any of the following:

- (a) Building permits shall not be required for any of the following:
  - (i) One-story detached accessory structures, if the floor area does not exceed 200 square feet (18.58 m<sup>2</sup>).
  - (ii) A fence that is not more than 6 feet (1 829 mm) high.
  - (iii) A retaining wall that is not more than 4 feet (1 219 mm) in height measured from the bottom of the footing to the top of the wall, unless supporting a surcharge.
  - (iv) A water tank supported directly upon grade if the capacity is not more than 5,000 gallons (18 927 L) and the ratio of height to diameter or width is not greater than 2 to 1.
  - (v) A sidewalk or driveway that is not more than 30 inches (762 mm) above adjacent grade and is not over any basement or story below.
  - (vi) Painting, papering, tiling, carpeting, cabinets, counter tops, and similar finish work.
  - (vii) A prefabricated swimming pool that is less than 24 inches (610 mm) deep.
  - (viii) Swings and other playground equipment accessory to a 1- or 2-family dwelling.
  - (ix) Window awnings supported by an exterior wall which do not project more than 54 inches (1 372 mm) from the exterior wall and do not require additional support.
- (b) Electrical permits shall not be required, as in accordance with the Michigan electrical code, R 408.30801 to R 408.30880, for any of the following:
  - (i) Repairs and maintenance: Minor repair work, including the replacement of lamps or the connection of approved portable electrical equipment to approved permanently installed receptacles.
  - (ii) Radio and television transmitting stations: The provisions of the code do not apply to electrical equipment used for radio and television transmissions, but do apply to equipment and wiring for power supply and to the installation of towers and antennas.
  - (iii) Temporary testing systems: A permit is not required for the installation of any temporary system required for the testing or servicing of electrical equipment or apparatus.
- (c) Mechanical permits shall not be required for any of the following:
  - (i) A portable heating or gas appliance that has inputs of less than 30,000 Btu's per hour.
  - (ii) Portable ventilation appliances and equipment.
  - (iii) A portable cooling unit.

- (iv) Steam, hot water, or chilled water piping within any heating or cooling equipment or appliances regulated by this code.
- (v) The replacement of any minor part that does not alter the approval of equipment or an appliance or make such equipment or appliance unsafe.
- (vi) A portable evaporative cooler.
- (vii) Self-contained refrigeration systems that contain 10 pounds (4.5 kg) or less of refrigerant, or that are actuated by motors of 1 horsepower (0.75kW) or less.
- (viii) Portable fuel cell appliances that are not connected to a fixed piping system and are not interconnected to a power grid.
- (ix) A boiler or pressure vessel for which a permit is required by sections 17 and 18 of 1965 PA 290, MCL 408.767 and 408.768.
- (x) An oil burner that does not require connection to a flue, such as an oil stove and a heater equipped with a wick.
- (xi) A portable gas burner that has inputs of less than 30,000 Btu's per hour.
- (xii) When changing or relocating a gas meter or regulator, a permit is not required when installing gas piping which shall be limited to 10 feet (3 005 mm) in length and not more than 6 fittings.

(d) Plumbing permits shall not be required for any of the following:

- (i) The stopping of leaks in drains, water, soil, waste or vent pipe; if any concealed trap, drain-pipe, water, soil, waste or vent pipe becomes defective and it becomes necessary to remove and replace the same with new material, then the work is considered as new work and a permit shall be obtained and inspection made as provided in the code.
- (ii) The clearing of stoppages or the repairing of leaks in pipes, valves, or fixtures, and the removal and reinstallation of water closets, if the repairs do not involve or require the replacement or rearrangement of valves, pipes, or fixtures.

R 408.30505

**R105.2.1 Emergency repairs.** Where *equipment* replacements and repairs must be performed in an emergency situation, the *permit* application shall be submitted within the next working business day to the *building official*.

**R105.2.2 Repairs.** Application or notice to the *building official* is not required for ordinary repairs to structures, replacement of lamps or the connection of *approved* portable electrical *equipment* to *approved* permanently installed receptacles. Such repairs shall not include the cutting away of any wall, partition or portion thereof, the removal or cutting of any structural beam or load-bearing support, or the



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Designation: F 1216-09

An American National Standard

## Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube<sup>1, 2</sup>

This standard is issued under the fixed designation F 1216; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice describes the procedures for the reconstruction of pipelines and conduits (4 to 108-in. diameter) by the installation of a resin-impregnated, flexible tube which is inverted into the existing conduit by use of a hydrostatic head or air pressure. The resin is cured by circulating hot water or introducing controlled steam within the tube. When cured, the finished pipe will be continuous and tight-fitting. This reconstruction process can be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, process piping, electrical conduits, and ventilation systems.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific precautionary statements, see 7.4.2.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>3</sup>

- D 543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents
- D 638 Test Method for Tensile Properties of Plastics
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D 903 Test Method for Peel or Stripping Strength of Adhesive Bonds
- D 1600 Terminology for Abbreviated Terms Relating to Plastics
- D 3567 Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
- D 3839 Guide for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
- D 5813 Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
- E 797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method
- F 412 Terminology Relating to Plastic Piping Systems

#### 2.2 AWWA Standard:

Manual on Cleaning and Lining Water Mains, M 28<sup>4</sup>

#### 2.3 NASSCO Standard:

Recommended Specifications for Sewer Collection System Rehabilitation<sup>5</sup>

<sup>1</sup>This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.67 on Trenchless Plastic Pipeline Technology.

Current edition approved March 1, 2009. Published March 2009. Originally approved in 1989. Last previous edition approved 2008 as F 1216 - 08.

<sup>2</sup>The following report has been published on one of the processes:

Driver, F. T., and Olson, M. R., "Demonstration of Sewer Relining by the Insituform Process, Northbrook, Illinois," EPA-600/2-83-064, Environmental Protection Agency, 1983. Interested parties can obtain copies from the Environmental Protection Agency or from a local technical library.

<sup>3</sup>For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup>Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, <http://www.awwa.org>.



### 3. Terminology

3.1 Definitions are in accordance with Terminology F 412 and abbreviations are in accordance with Terminology D 1600, unless otherwise specified.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *cured-in-place pipe (CIPP)*—a hollow cylinder containing a nonwoven or a woven material, or a combination of nonwoven and woven material surrounded by a cured thermosetting resin. Plastic coatings may be included. This pipe is formed within an existing pipe. Therefore, it takes the shape of and fits tightly to the existing pipe.

3.2.2 *inversion*—the process of turning the resin-impregnated tube inside out by the use of water pressure or air pressure.

3.2.3 *lift*—a portion of the CIPP that has cured in a position such that it has pulled away from the existing pipe wall.

### 4. Significance and Use

4.1 This practice is for use by designers and specifiers, regulatory agencies, owners, and inspection organizations who are involved in the rehabilitation of conduits through the use of a resin-impregnated tube inverted through the existing conduit. As for any practice, modifications may be required for specific job conditions.

### 5. Materials

5.1 *Tube*—The tube should consist of one or more layers of flexible needled felt or an equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube should be compatible with the resin system used. The material should be able to stretch to fit irregular pipe sections and negotiate bends. The outside layer of the tube should be plastic coated with a material that is compatible with the resin system used. The tube should be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. Allowance should be made for circumferential stretching during inversion.

5.2 *Resin*—A general purpose, unsaturated, styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible with the inversion process should be used. The resin must be able to cure in the presence of water and the initiation temperature for cure should be less than 180°F (82.2°C). The CIPP system can be expected to have as a minimum the initial structural properties given in Table 1. These physical strength properties should be determined in accordance with Section 8.

### 6. Design Considerations

6.1 *General Guidelines*—The design thickness of the CIPP is largely a function of the condition of the existing pipe. Design equations and details are given in Appendix X1.

### 7. Installation

#### 7.1 Cleaning and Inspection:

7.1.1 Prior to entering access areas such as manholes, and performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal safety regulations.

7.1.2 *Cleaning of Pipeline*—All internal debris should be removed from the original pipeline. Gravity pipes should be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment (see NASSCO Recommended Specifications for Sewer Collection System Rehabilitation). Pressure pipelines should be cleaned with cable-attached devices or fluid-propelled devices as shown in AWWA Manual on Cleaning and Lining Water Mains, M 28.

7.1.3 *Inspection of Pipelines*—Inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television or man entry. The interior of the pipeline should be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and reductions in the cross-sectional area of more than 40 %. These conditions should be noted so that they can be corrected.

7.1.4 *Line Obstructions*—The original pipeline should be clear of obstructions such as solids, dropped joints, protruding service connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 40 % that will prevent the insertion of the resin-impregnated tube. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then a point repair excavation should be made to uncover and remove or repair the obstruction.

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<sup>5</sup> Available from the National Association of Sewer Service Companies, 101 Wymore Rd., Suite 501, Altamonte, FL 32714.





**7.2 Resin Impregnation**—The tube should be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter. The volume should be adjusted by adding 5 to 10 % excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

**7.3 Bypassing**—If bypassing of the flow is required around the sections of pipe designated for reconstruction, the bypass should be made by plugging the line at a point upstream of the pipe to be reconstructed and pumping the flow to a downstream point or adjacent system. The pump and bypass lines should be of adequate capacity and size to handle the flow. Services within this reach will be temporarily out of service.

**7.3.1** Public advisory services will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

**7.4 Inversion:**

**7.4.1 Using Hydrostatic Head**—The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole or termination point. The tube should be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, the tube should be turned inside out and attached to the standpipe so that a leakproof seal is created. The inversion head should be adjusted to be of sufficient height to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections. Care should be taken during the inversion so as not to over-stress the felt fiber.

**7.4.1.1** An alternative method of installation is a top inversion. In this case, the tube is attached to a top ring and is inverted to form a standpipe from the tube itself or another method accepted by the engineer.

NOTE 1—The tube manufacturer should provide information on the maximum allowable tensile stress for the tube.

**7.4.2 Using Air Pressure**—The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of air pressure sufficient to fully extend it to the next designated manhole or termination point. The tube should be connected by an attachment at the upper end of the guide chute so that a leakproof seal is created and with the impermeable plastic membranes side out. As the tube enters the guide chute, the tube should be turned inside out. The inversion air pressure should be adjusted to be of sufficient pressure to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections. Care should be taken during the inversion so as not to overstress the woven and nonwoven materials.

NOTE 2—**Warning:** Suitable precautions should be taken to eliminate hazards to personnel in the proximity of the construction when pressurized air is being used.

**7.4.3 Required Pressures**—Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube. Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed.

**7.5 Lubricant**—The use of a lubricant during inversion is recommended to reduce friction during inversion. This lubricant should be poured into the inversion water in the downtube or applied directly to the tube. The lubricant used should be a nontoxic, oil-based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

**7.6 Curing:**

**7.6.1 Using Circulating Heated Water**—After inversion is completed, a suitable heat source and water recirculation equipment are required to circulate heated water throughout the pipe. The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin. Water temperature in the line during the cure period should be as recommended by the resin manufacturer.

**7.6.1.1** The heat source should be fitted with suitable monitors to gage the temperature of the incoming and outgoing water supply. Another such gage should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure.

**7.6.1.2** Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature should be raised to the post-cure temperature recommended by the resin manufacturer. The post-cure temperature should be held for a period as recommended by the resin manufacturer,



during which time the recirculation of the water and cycling of the boiler to maintain the temperature continues. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

**7.6.2 Using Steam**—After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe. The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin. The temperature in the line during the cure period should be as recommended by the resin manufacturer.

**7.6.2.1** The steam-generating equipment should be fitted with a suitable monitor to gage the temperature of the outgoing steam. The temperature of the resin being cured should be monitored by placing gages between the impregnated tube and the existing pipe at both ends to determine the temperature during cure.

**7.6.2.2** Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature should be raised to post-cure temperatures recommended by the resin manufacturer. The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the distribution and control of steam to maintain the temperature continues. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

**7.6.3 Required Pressures**—As required by the purchase agreement, the estimated maximum and minimum pressure required to hold the flexible tube tight against the existing conduit during the curing process should be provided by the seller and shall be increased to include consideration of the external ground water, if present. Once the cure has started and dimpling for laterals is completed, the required pressures should be maintained until the cure has been completed. For water or steam, the pressure should be maintained within the estimated maximum and minimum pressure during the curing process. If the steam pressure or hydrostatic head drops below the recommended minimum during the cure, the CIPP should be inspected for lifts or delaminations and evaluated for its ability to fully meet the applicable requirements of 7.8 and Section 8.

#### **7.7 Cool-Down:**

**7.7.1 Using Cool Water After Heated Water Cure**—The new pipe should be cooled to a temperature below 100°F (38°C) before relieving the static head in the inversion standpipe. Cool-down may be accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. Care should be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed pipe.

**7.7.2 Using Cool Water After Steam Cure**—The new pipe should be cooled to a temperature below 113°F (45°C) before relieving the internal pressure within the section. Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end. Care should be taken in the release of the air pressure so that a vacuum will not be developed that could damage the newly installed pipe.

**7.8 Workmanship**—The finished pipe should be continuous over the entire length of an inversion run and be free of dry spots, lifts, and delaminations. If these conditions are present, remove and replace the CIPP in these areas.

**7.8.1** If the CIPP does not fit tightly against the original pipe at its termination point(s), the space between the pipes should be sealed by filling with a resin mixture compatible with the CIPP.

**7.9 Service Connections**—After the new pipe has been cured in place, the existing active service connections should be reconnected. This should generally be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a remote-control cutting device.

## **8. Inspection Practices**

**8.1** For each inversion length designated by the owner in the Contract documents or purchase order, the preparation of a CIPP sample is required, using one of the following two methods, depending on the size of the host pipe.

**8.1.1** For pipe sizes of 18 in. or less, the sample should be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.

**8.1.2** In medium and large-diameter applications and areas with limited access, the sample should be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the downtube when circulating heated water is used and in the silencer when steam is used. This method can also be used for sizes 18 in. or less, in situations where preparing samples in accordance with 8.1.1 can not be obtained due to physical constraints, if approved by the owner.

**8.1.3** The samples for each of these cases should be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and also for tensile testing, if applicable. The following test procedures should be followed after the sample is cured and removed.



8.1.3.1 *Short-Term Flexural (Bending) Properties*—The initial tangent flexural modulus of elasticity and flexural stress should be measured for gravity and pressure pipe applications in accordance with Test Methods D 790 and should meet the requirements of Table 1.

8.1.3.2 *Tensile Properties*—The tensile strength should be measured for pressure pipe applications in accordance with Test Method D 638 and must meet the requirements of Table 1.

8.2 *Gravity Pipe Leakage Testing*—If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an exfiltration test method where the CIPP is plugged at both ends and filled with water. This test should take place after the CIPP has cooled down to ambient temperature. This test is limited to pipe lengths with no service laterals and diameters of 36 in. or less. The allowable water exfiltration for any length of pipe between termination points should not exceed 50 U.S. gallons per inch of internal pipe diameter per mile per day, providing that all air has been bled from the line. During exfiltration testing, the maximum internal pipe pressure at the lowest end should not exceed 10 ft (3.0 m) of water or 4.3 psi (29.7 kPa) and the water level inside of the inversion standpipe should be 2 ft (0.6 m) higher than the top of the pipe or 2 ft higher than the groundwater level, whichever is greater. The leakage quantity should be gaged by the water level in a temporary standpipe placed in the upstream plug. The test should be conducted for a minimum of one hour.

NOTE 3—It is impractical to test pipes above 36-in. diameter for leakage due to the technology available in the pipe rehabilitation industry. Post inspection of larger pipes will detect major leaks or blockages.

8.3 *Pressure Pipe Testing*—If required by the owner in the contract documents or purchase order, pressure pipes should be subjected to a hydrostatic pressure test. A recommended pressure and leakage test would be at twice the known working pressure or at the working pressure plus 50 psi, whichever is less. Hold this pressure for a period of two to three hours to allow for stabilization of the CIPP. After this period, the pressure test will begin for a minimum of one hour. The allowable leakage during the pressure test should be 20 U.S. gallons per inch of internal pipe diameter per mile per day, providing that all air has been evacuated from the line prior to testing and the CIPP has cooled down to ambient temperature.

NOTE 4—The allowable leakage for gravity and pressure pipe testing is a function of water loss at the end seals and trapped air in the pipe.

8.4 *Delamination Test*—If required by the owner in the contract documents or purchase order, a delamination test should be performed on each inversion length specified. The CIPP samples should be prepared in accordance with 8.1.2, except that a portion of the tube material in the sample should be dry and isolated from the resin in order to separate tube layers for testing. (Consult the tube manufacturer for further information.) Delamination testing shall be in accordance with Test Method D 903, with the following exceptions:

8.4.1 The rate of travel of the power-actuated grip shall be 1 in. (25 mm)/min.

8.4.2 Five test specimens shall be tested for each inversion specified.

8.4.3 The thickness of the test specimen shall be minimized, but should be sufficient to adequately test delamination of nonhomogeneous CIPP layers.

8.5 The peel or stripping strength between any nonhomogeneous layers of the CIPP laminate should be a minimum of 10 lb/in. (178.60 g/mm) of width for typical CIPP applications.

NOTE 5—The purchaser may designate the dissimilar layers between which the delamination test will be conducted.

NOTE 6—For additional details on conducting the delamination test, contact the CIPP contractor.

8.6 *CIPP Wall Thickness*—The method of obtaining CIPP wall thickness measurements should be determined in a manner consistent with 8.1.2 of Specification D 5813. Thickness measurements should be made in accordance with Practice D 3567 for samples prepared in accordance with 8.1. Make a minimum of eight measurements at evenly spaced intervals around the circumference of the pipe to ensure that minimum and maximum thicknesses have been determined. Deduct from the measured values the thickness of any plastic coatings or CIPP layers not included in the structural design of the CIPP. The average thickness should be calculated using all measured values and shall meet or exceed minimum design thickness as agreed upon between purchaser and seller. The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness as agreed upon between purchase and seller.



**8.6.1 Ultrasonic Testing of Wall Thickness**—An alternative method to 8.6 for measuring the wall thickness may be performed within the installed CIPP at either end of the pipe by the ultrasonic pulse echo method as described in Practice E 797. A minimum of eight (8) evenly spaced measurements should be made around the internal circumference of the installed CIPP within the host pipe at a distance of 12 to 18 in. from the end of the pipe. For pipe diameters of fifteen (15) in. or greater, a minimum of sixteen (16) evenly spaced measurements shall be recorded. The ultrasonic method to be used is the flaw detector with A-scan display and direct thickness readout as defined in 6.1.2 of E 797. A calibration block shall be manufactured from the identical materials used in the installed CIPP to calibrate sound velocity through the liner. Calibration of the transducer shall be performed daily in accordance with the equipment manufacturer's recommendations. The average thickness should be calculated using all measured values and shall meet or exceed minimum design thickness as agreed upon between purchaser and seller. The minimum wall thickness at any point shall not be less than 87.5 % of the specified design thickness as agreed upon between purchaser and seller.

**8.7 Inspection and Acceptance**—The installation may be inspected visually if appropriate, or by closed-circuit television if visual inspection cannot be accomplished. Variations from true line and grade may be inherent because of the conditions of the original piping. No infiltration of groundwater should be observed. All service entrances should be accounted for and be unobstructed.

**TABLE 1 CIPP Initial Structural Properties <sup>A</sup>**

Property	Test Method	Minimum Value	
		psi	(MPa)
Flexural strength	D 790	4 500	(31)
Flexural modulus	D 790	250 000	(1 724)
Tensile strength (for pressure pipes only)	D 638	3 000	(21)

<sup>A</sup>The values in Table 1 are for field inspection. The purchaser should consult the manufacturer for the long-term structural properties.



## APPENDIXES

### (Nonmandatory Information)

## X1. DESIGN CONSIDERATIONS

### X1.1 Terminology :

X1.1.1 *partially deteriorated pipe*— the original pipe can support the soil and surcharge loads throughout the design life of the rehabilitated pipe. The soil adjacent to the existing pipe must provide adequate side support. The pipe may have longitudinal cracks and up to 10.0% distortion of the diameter. If the distortion of the diameter is greater than 10.0%, alternative design methods are required (see Note 1).

X1.1.2 *fully deteriorated pipe*— the original pipe is not structurally sound and cannot support soil and live loads or is expected to reach this condition over the design life of the rehabilitated pipe. This condition is evident when sections of the original pipe are missing, the pipe has lost its original shape, or the pipe has corroded due to the effects of the fluid, atmosphere, soil, or applied loads.

### X1.2 Gravity Pipe:

X1.2.1 *Partially Deteriorated Gravity Pipe Condition*—The CIPP is designed to support the hydraulic loads due to groundwater, since the soil and surcharge loads can be supported by the original pipe. The groundwater level should be determined by the purchaser and the thickness of the CIPP should be sufficient to withstand this hydrostatic pressure without collapsing. The following equation may be used to determine the thickness required:

$$P = \frac{2KE_L}{(1 - \nu^2)} \cdot \frac{1}{(DR - 1)^3} \cdot \frac{C}{N} \quad (X1.1)$$

where:

$P$	=	groundwater load, psi (MPa), measured from the invert of the pipe
$K$	=	enhancement factor of the soil and existing pipe adjacent to the new pipe (a minimum value of 7.0 is recommended where there is full support of the existing pipe),
$E_L$	=	long-term (time corrected) modulus of elasticity for CIPP, psi (MPa) (see Note X1.1),
$\nu$	=	Poisson's ratio (0.3 average),
$DR$	=	dimension ratio of CIPP,
$C$	=	ovality reduction factor =

$$\left( \left[ 1 - \frac{\Delta}{100} \right] / \left[ 1 + \frac{\Delta}{100} \right]^2 \right)^3$$

$\Delta$  = percentage ovality of original pipe =

$$100 \times \frac{(\text{Mean Inside Diameter} - \text{Minimum Inside Diameter})}{\text{Mean Inside Diameter}}$$

or

$$100 \times \frac{(\text{Maximum Inside Diameter} - \text{Mean Inside Diameter})}{\text{Mean Inside Diameter}}$$

and

$N$  = factor of safety.

NOTE X1.1—The choice of value (from manufacturer's literature) of  $E_L$  will depend on the estimated duration of the application of the load,  $P$ , in relation to the design life of the structure. For example, if the total duration of the load,  $P$ , is estimated to be 50 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value for  $E_L$  will be that given for 50 years of continuous loading at the maximum ground or fluid temperature expected to be reached over the life of the structure.

NOTE X1.2—If there is no groundwater above the pipe invert, the CIPP should typically have a maximum  $SDR$  of 100, dependent upon design conditions.

X1.2.1.1 If the original pipe is oval, the CIPP design from Eq. X1.1 shall have a minimum thickness as calculated by the following formula:

$$1.5 \frac{\Delta}{100} \left( 1 + \frac{\Delta}{100} \right) DR^2 - 0.5 \left( 1 + \frac{\Delta}{100} \right) DR = \frac{\sigma_L}{PN} \quad (\text{X1.2})$$

where:

$\sigma_L$  = long-term (time corrected) flexural strength for CIPP, psi (MPa) (see Note X1.5).

X1.2.1.2 See Table X1.1 for typical design calculations.

X1.2.2 *Fully Deteriorated Gravity Pipe Condition*—The CIPP is designed to support hydraulic, soil, and live loads. The groundwater level, soil type and depth, and live load should be determined by the purchaser, and the following equation should be used to calculate the CIPP thickness required to withstand these loads without collapsing:

$$q_t = \frac{I}{N} [32 R_w B' E'_s C (E_L I / D^3)]^{1/2} \quad (\text{X1.3})$$

where:

$q_t$  = total external pressure on pipe, psi (MPa),  
 $\quad \quad \quad = 0.433 H_w + wHR_w/144 + W_s$ , (English Units),  
 $\quad \quad \quad = 0.00981 H_w + wHR_w/1000 + W_s$ , (Metric Units)  
 $R_w$  = water buoyancy factor ( $0.67 \text{ min}$ )  $= 1 - 0.33 (H_w/H)$ ,  
 $w$  = soil density, lb.ft<sup>3</sup> (KN/m<sup>3</sup>),  
 $W_s$  = live load, psi (Mpa),



$H_w$	=	height of water above top of pipe, ft (m)
$H$	=	height of soil above top of pipe, ft (m),
$B'$	=	coefficient of elastic support = $1/(1 + 4e^{-0.065H})$ inch-pound units, $(1/(1 + 4e^{-0.213H}))$ SI units
$I$	=	moment of inertia of CIPP, in. <sup>4</sup> /in. (mm <sup>4</sup> /mm) = $t^3/12$ ,
$t$	=	thickness of CIPP, in. (mm),
$C$	=	ovality reduction factor (see X1.2.1),
$N$	=	factor of safety,
$E'_s$	=	modulus of soil reaction, psi (MPa) (see Note X1.4),
$E_L$	=	long-term modulus of elasticity for CIPP, psi (MPa), and
$D$	=	mean inside diameter of original pipe, in. (mm)

X1.2.2.1 The CIPP design from Eq. X1.3 should have a minimum thickness as calculated by the following formula:

$$\frac{EI}{D^3} = \frac{E}{12(DR)^3} \geq 0.093 \text{ (inch-pound units)}, \quad (\text{X1.4})$$

OR

$$\frac{E}{12(DR)^3} \geq 0.00064 \text{ (SI units)}$$

where:

$E$  = initial modulus of elasticity, psi (MPa)

NOTE X1.3—For pipelines at depth not subject to construction disturbance, or if the pipeline was originally installed using tunneling method, the soil load may be calculated using a tunnel load analysis. Finite element analysis is an alternative design method for noncircular pipes.

NOTE X1.4—For definition of modulus of soil reaction, see Practice D 3839.

X1.2.2.2 The minimum CIPP design thickness for a fully deteriorated condition should also meet the requirements of Eq. X1.1 and X1.2.

### X1.3 Pressure Pipe:

X1.3.1 *Partially Deteriorated Pressure Condition*—A CIPP installed in an existing underground pipe is designed to support external hydrostatic loads due to groundwater as well as withstand the internal pressure in spanning across any holes in the original pipe wall. The results of Eq. X1.1 are compared to those from Eq. X1.6 or Eq. X1.7, as directed by Eq. X1.5, and the largest of the thicknesses is selected. In an above-ground design condition, the CIPP is designed to withstand the internal pressure only by using Eq. X1.5–X1.7 as applicable.

X1.3.1.1 If the ratio of the hole in the original pipe wall to the pipe diameter does not exceed the quantity shown in Eq. X1.5, then the CIPP is assumed to be a circular flat plate fixed at the edge and subjected to transverse pressure only. In this case, Eq. X1.6 is used for design. For holes larger than the  $d/D$  value in Eq. X1.5, the liner cannot be considered in flat plate loading, but rather in ring tension or hoop stress, and Eq. X1.7 is used.

$$\frac{d}{D} \leq 1.83 \left( \frac{t}{D} \right)^{1/2} \quad (\text{X1.5})$$

where:

$d$	=	diameter of hole or opening in original pipe wall, in. (mm),
$D$	=	mean inside diameter of original pipe, in. (mm), and
$t$	=	thickness of CIPP, in. (mm).

$$P = \frac{5.33}{(DR - 1)^2} \left( \frac{D}{d} \right)^2 \frac{\sigma_L}{N}$$

(X1.6)

where:

$DR$	=	dimension ratio of CIPP,
$D$	=	mean inside diameter of original pipe, in. (mm),
$d$	=	diameter of hole or opening in original pipe wall, in. (mm),
$\sigma_L$	=	long-term (time corrected) flexural strength for CIPP, psi (MPa) (see Note X1.5), and
$N$	=	factor of safety.

NOTE X1.5—The choice of value (from manufacturer's literature) of  $\sigma_L$  will depend on the estimated duration of the application of the load,  $P$ , in relation to the design life of the structure. For example, if the total duration of the load,  $P$ , is estimated to be 50 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value of  $\sigma_L$  will be that given for 50 years of continuous loading at the maximum ground or fluid temperature expected to be reached over the life of the structure.

X1.3.2 *Fully Deteriorated Pressure Pipe Condition*—A CIPP to be installed in an underground condition is designed to withstand all external loads and the full internal pressure. The design thicknesses are calculated from Eq. X1.1, Eq. X1.3, Eq. X1.4, and Eq. X1.7, and the largest thickness is selected. If the pipe is above ground, the CIPP is designed to withstand internal pressure only by using Eq. X1.7.

$$P = \frac{2\sigma_{TL}}{(DR - 2)N}$$

(X1.7)

where:

$P$	=	internal pressure, psi (MPa),
$\sigma_{TL}$	=	long-term (time corrected) tensile strength for CIPP, psi (MPa) (see Note 12),
$DR$	=	dimension ratio of CIPP, and
$N$	=	factor of safety.



NOTE X1.6—The choice of value (from manufacturer's literature) of  $\sigma_{TL}$  will depend on the estimated duration of the application of the load,  $P$ , in relation to the design life of the structure. For example, if the total duration of the load,  $P$ , is estimated to be 50 years, either continuously applied, or the sum of intermittent periods of loading, the appropriately conservative choice of value of  $\sigma_{TL}$  will be that given for 50 years of continuous loading at the maximum ground or fluid temperature expected to be reached over the life of the structure.

X1.4 — *Negative Pressure*—Where the pipe is subject to a vacuum, the CIPP should be designed as a gravity pipe with the external hydrostatic pressure increased by an amount equal to the negative pressure.

NOTE X1.7—Table X1.1 presents maximum groundwater loads for partially deteriorated pipes for selected typical nominal pipe sizes. CIPP is custom made to fit the original pipe and can be fabricated to a variety of sizes from 4 to 96-in. diameter which would be impractical to list here.

**TABLE X1.1 Maximum Groundwater Loads for Partially Deteriorated Gravity Pipe Condition**

Diameter, in. (Inside Diameter of Original Pipe)	Nominal CIPP Thickness, mm	CIPP Thickness, t, in.	Maximum Allowable Ground- water Load <sup>A</sup> (above invert)	
			ft	m
8	6	0.236	40.0	12.2
10	6	0.236	20.1	6.1
12	6	0.236	11.5	3.5
15	9	0.354	20.1	6.1
18	9	0.354	11.5	3.5
18	12	0.472	27.8	8.5
24	12	0.472	11.5	3.5
24	15	0.591	22.8	6.9
30	15	0.591	11.5	3.5
30	18	0.709	20.1	6.1

<sup>A</sup>Assumes  $K = 7.0$ ,  $E = 125\,000$  psi (862 MPa) (50-year strength),  $\nu = 0.30$ ,  $C = 0.64$  (5 % ovality), and  $N = 2.0$

## X2. CHEMICAL-RESISTANCE TESTS

### X2.1 Scope:

X2.1.1 This appendix covers the test procedures for chemical-resistance properties of CIPP. Minimum standards are presented for standard domestic sewer applications.

### X2.2 Procedure for Chemical-Resistance Testing:

X2.2.1 Chemical resistance tests should be completed in accordance with Practices D 543. Exposure should be for a minimum of one month at 73.4°F (23°C). During this period, the CIPP test specimens should lose no more than 20 % of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of this practice.

X2.2.2 Table X2.1 presents a list of chemical solutions that serve as a recommended minimum requirement for the chemical-resistant properties of CIPP in standard domestic sanitary sewer applications.

X2.2.3 For applications other than standard domestic sewage, it is recommended that chemical-resistance tests be conducted with actual samples of the fluid flowing in the pipe. These tests can also be accomplished by depositing CIPP test specimens in the active pipe.





F 1216

### SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F 1216-08) that may impact the use of this standard. (Approved March 1, 2009.)

(1) 8.1, 8.1.1 and 8.1.2 were revised.

**SUMMARY OF CHANGES**

Committee F17 has identified the location of selected changes to this standard since the last issue (F 1217-07b) that may impact the use of this standard.

- (1) Added Practices D 3567, E 797, and Specification D 5813 to Section 2, Reference Documents.
- (2) Added 8.6 and 8.6.1 to include an alternative method of wall thickness measurement by Ultrasonic Methods.
- (3) Renumbered Inspection and Acceptance from 8.6 to 8.7.

**TABLE X2.1 Minimum Chemical Resistance Requirements for Domestic Sanitary Sewer Applications**

Chemical Solution	Concentration, %
Tap water (pH 6-9)	100
Nitric acid	5
Phosphoric acid	10
Sulfuric acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

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permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

**106.5.8 Posting of permit.** The permit or a copy shall be kept on the site of the work until the completion of the project.

**106.6 Fees.** The fees prescribed by the act shall be paid to the enforcing agency of the jurisdiction before a permit to begin work for new construction, alteration, removal, demolition, or other building operation may be issued. In addition, an amendment to a permit necessitating an additional fee shall not be approved until the additional fee is paid.

R 408.30716

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## SECTION 107 INSPECTIONS AND TESTING

**107.1 General.** The code official is authorized to conduct such inspections as are deemed necessary to determine compliance with the provisions of this code. Construction or work for which a permit is required shall be subject to inspection by the code official, and such construction or work shall remain accessible and exposed for inspection purposes until *approved*. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Inspections presuming to give authority to violate or cancel the provisions of this code or of other ordinances of the jurisdiction shall not be valid. It shall be the duty of the permit applicant to cause the work to remain accessible and exposed for inspection purposes. Neither the code official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material required to allow inspection.

**107.2 Required inspections and testing.** The code official, upon notification from the permit holder or the permit holder's agent, shall make the following inspections and such other inspections as necessary, and shall either release that portion of the construction or shall notify the permit holder or an agent of any violations that must be corrected. The holder of the permit shall be responsible for the scheduling of such inspections.

1. Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before any backfill is put in place.
2. Rough-in inspection shall be made after the roof, framing, fireblocking, firestopping, draftstopping and bracing is in place and all sanitary, storm and water distribution piping is roughed-in, and prior to the installation of wall or ceiling membranes.
3. Final inspection shall be made after the building is complete, all plumbing fixtures are in place and properly connected, and the structure is ready for occupancy.

**107.2.1 Other inspections.** In addition to the inspections specified above, the code official is authorized to make or

require other inspections of any construction work to ascertain compliance with the provisions of this code and other laws that are enforced.

**107.2.2 Inspection requests.** It shall be the duty of the holder of the permit or their duly authorized agent to notify the code official when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for inspections of such work that are required by this code.

**107.2.3 Approval required.** Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the code official. The code official, upon notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed, or notify the permit holder or his or her agent wherein the same fails to comply with this code. Any portions that do not comply shall be corrected and such portion shall not be covered or concealed until authorized by the code official.

**107.2.4 Approved agencies.** The code official is authorized to accept reports of *approved* inspection agencies, provided that such agencies satisfy the requirements as to qualifications and reliability.

**107.3 Special inspections.** Special inspections of *alternative engineered design* plumbing systems shall be conducted in accordance with Sections 107.3.1 and 107.3.2.

**107.3.1 Periodic inspection.** The registered design professional or designated inspector shall periodically inspect and observe the *alternative engineered design* to determine that the installation is in accordance with the *approved* construction documents. All discrepancies shall be brought to the immediate attention of the plumbing contractor for correction. Records shall be kept of all inspections.

**107.3.2 Written report.** The registered design professional shall submit a final report in writing to the code official upon completion of the installation, certifying that the *alternative engineered design* conforms to the *approved* construction documents. A notice of approval for the plumbing system shall not be issued until a written certification has been submitted.

**107.4 Testing.** Plumbing work and systems shall be tested as required in Section 312 and in accordance with Sections 107.4.1 through 107.4.3. Tests shall be made by the permit holder and observed by the code official.

**107.4.1 New, altered, extended or repaired systems.** New plumbing systems and parts of existing systems that have been altered, extended or repaired shall be tested as prescribed herein to disclose leaks and defects, except that testing is not required in the following cases:

- 1 In any case that does not include addition to, replacement, alteration or relocation of any water supply, drainage or vent piping.
- 2 In any case where plumbing equipment is set up temporarily for exhibition purposes.

**107.4.2 Equipment, material and labor for tests.** All equipment, material and labor required for testing a plumbing system or part thereof shall be furnished by the permit holder.

**107.4.3 Reinspection and testing.** Where any work or installation does not pass any initial test or inspection, the necessary corrections shall be made to comply with this code. The work or installation shall then be resubmitted to the code official for inspection and testing.

**107.5 Approval.** After the prescribed tests and inspections indicate that the work complies in all respects with this code, a notice of approval shall be issued by the code official.

**107.5.1 Revocation.** The code official is authorized to, in writing, suspend or revoke a notice of approval issued under the provisions of this code wherever the notice is issued in error, or on the basis of incorrect information supplied, or where it is determined that the building or structure, premise or portion thereof is in violation of any ordinance or regulation or any of the provisions of this code.

**107.6 Temporary connection.** The code official shall have the authority to authorize the temporary connection of the building or system to the utility source for the purpose of testing plumbing systems or for use under a temporary certificate of occupancy.

**107.7 Connection of service utilities.** A person shall not make connections from a utility, source of energy, fuel, power, water system or sewer system to any building or system that is regulated by this code for which a permit is required until authorized by the code official.

## SECTION 108 VIOLATIONS

**108.1 Unlawful acts.** It shall be unlawful for any person, firm or corporation to erect, construct, alter, repair, remove, demolish or utilize any plumbing system, or cause same to be done, in conflict with or in violation of any of the provisions of this code.

**108.2 Notice of violation.** The code official shall serve a notice of violation or order to the person responsible for the erection, installation, alteration, extension, repair, removal or demolition of plumbing work in violation of the provisions of this code, or in violation of a detail statement or the approved construction documents thereunder, or in violation of a permit or certificate issued under the provisions of this code. Such order shall direct the discontinuance of the illegal action or condition and the abatement of the violation.

**108.3 Prosecution of violation.** If the notice of violation is not complied with promptly, the code official shall request the legal counsel of the jurisdiction to institute the appropriate proceeding at law or in equity to restrain, correct or abate such violation, or to require the removal or termination of the unlawful occupancy of the structure in violation of the provisions of this code or of the order or direction made pursuant thereto.

**108.4 Violation penalties.** A person who violates a provision of the code, who fails to conform with any of the requirements thereof, or who erects, installs, alters, or repairs plumbing work in violation of the approved construction documents or directive of the enforcing agency, or a permit or certificate issued under the provisions of the code shall be assessed a fine in accordance with the act and 2002 PA 733, MCL 338.3511 to 338.3569.

R 408.30718

**108.5 Stop work orders.** Notice shall be in accordance with the act. A person who is served with a stop work order, except for work that the person is directed to perform to remove a violation or unsafe condition is subject to the penalty provisions prescribed by the act.

R 408.30719

**108.6 Abatement of violation.** The imposition of the penalties herein prescribed shall not preclude the legal officer of the jurisdiction from instituting appropriate action to prevent unlawful construction or to restrain, correct or abate a violation, or to prevent illegal occupancy of a building, structure or premises, or to stop an illegal act, conduct, business or utilization of the plumbing on or about any premises.

**108.7 Unsafe plumbing.** Any plumbing regulated by this code that is unsafe or that constitutes a fire or health hazard, insanitary condition, or is otherwise dangerous to human life is hereby declared unsafe. Any use of plumbing regulated by this code constituting a hazard to safety, health or public welfare by reason of inadequate maintenance, dilapidation, obsolescence, fire hazard, disaster, damage or abandonment is hereby declared an unsafe use. Any such unsafe equipment is hereby declared to be a public nuisance and shall be abated by repair, rehabilitation, demolition or removal.

**108.7.1 Authority to condemn equipment.** Whenever the code official determines that any plumbing, or portion thereof, regulated by this code has become hazardous to life, health or property or has become insanitary, the code official shall order in writing that such plumbing either be removed or restored to a safe or sanitary condition. A time limit for compliance with such order shall be specified in the written notice. No person shall use or maintain defective plumbing after receiving such notice.

When such plumbing is to be disconnected, written notice as prescribed in Section 108.2 shall be given. In cases of immediate danger to life or property, such disconnection shall be made immediately without such notice.

**108.7.2 Authority to disconnect service utilities.** The code official shall have the authority to authorize disconnection of utility service to the building, structure or system regulated by the technical codes in case of an emergency, where necessary, to eliminate an immediate danger to life or property. Where possible, the owner and occupant of the building, structure or service system shall be notified of the decision to disconnect utility service prior to taking such action. If not notified prior to disconnecting, the owner or occupant of the building, structure or service systems shall be notified in writing, as soon as practical thereafter.



## SECTION 312 TESTS AND INSPECTIONS

**312.1 Required tests.** The permit holder shall make the applicable tests prescribed in sections 312.2 to 312.10.2 to determine compliance with the code. The permit holder shall give reasonable advance notice to the code official when the plumbing work is ready for testing. The equipment, material, power, and labor necessary for the inspection and test shall be furnished by the permit holder and the permit holder shall be responsible for determining that the work will withstand the test pressure prescribed in this rule. All plumbing system piping shall be tested with either water or, for piping systems other than plastic, by air. After the plumbing fixtures have been set and their traps filled with water, the entire drainage system shall be submitted to final tests. The code official shall require the removal of any cleanouts if necessary to ascertain if the pressure has reached all parts of the system.

**Exception:** Drainage and vent low pressure air tests for plastic piping systems shall be acceptable as prescribed in section 312.3 of the code.

R 408.30721

**312.2 Drainage and vent water test.** A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot (3048 mm) head of water. In testing successive sections, at least the upper 10 feet (3048 mm) of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet (3048 mm) of the system, shall have been submitted to a test of less than a 10-foot (3048 mm) head of water. This pressure shall be held for not less than 15 minutes. The system shall then be tight at all points.

**312.3 Drainage and vent air test.** An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi (34.5 kPa) or sufficient to balance a 10-inch (254 mm) column of mercury. This pressure shall be held for a test period of not less than 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperatures or the seating of gaskets shall be made before to the beginning of the test period.

R 408.30721

**312.4 Drainage and vent final test.** The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of this code. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column (248.8 Pa) shall be held for a test period of not less than 15 minutes.

**312.5 Water supply system test.** Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested and proved tight under a water pressure not less than the working pressure of the system; or, for piping systems other than plastic, by an air test of not less than 50 psi (344 kPa). This pressure shall be held for not less than 15 minutes. The water utilized for tests shall be obtained from a potable source of supply. The required tests shall be performed in accordance with this section and Section 107.

**312.6 Gravity sewer test.** Gravity sewer tests shall consist of plugging the end of the *building sewer* at the point of connection with the *public sewer*, filling the *building sewer* with water, testing with not less than a 10-foot (3048 mm) head of water and maintaining such pressure for 15 minutes.

**312.7 Forced sewer test.** Forced sewer tests shall consist of plugging the end of the *building sewer* at the point of connection with the *public sewer* and applying a pressure of 5 psi (34.5 kPa) greater than the pump rating, and maintaining such pressure for 15 minutes.

**312.8 Storm drainage system test.** Storm drain systems within a building shall be tested by water or air in accordance with Section 312.2 or 312.3.

**312.9 Shower liner test.** Where shower floors and receptors are made water-tight by the application of materials required by Section 417.5.2, the completed liner installation shall be tested. The pipe from the shower drain shall be plugged water tight for the test. The floor and receptor area shall be filled with potable water to a depth of not less than 2 inches (51 mm) measured at the threshold. Where a threshold of at least 2 inches (51 mm) high does not exist, a temporary threshold shall be constructed to retain the test water in the lined floor or receptor area to a level not less than 2 inches (51 mm) deep measured at the threshold. The water shall be retained for a test period of not less than 15 minutes, and there shall not be evidence of leakage.

**312.10 Inspection and testing of backflow prevention assemblies.** Inspection and testing shall comply with Sections 312.10.1 and 312.10.2.

**312.10.1 Inspections.** Annual inspections shall be made of all backflow prevention assemblies and air gaps to determine whether they are operable.

**312.10.2 Testing.** Reduced pressure principle, double check, pressure vacuum breaker, reduced pressure detector fire protection, double check detector fire protection, and spill-resistant vacuum breaker backflow preventer assemblies and hose connection backflow preventers shall be tested at the time of installation, immediately after repair or relocation and at least annually. The testing procedure shall be performed in accordance with one of the following standards: ASSE 5013, ASSE 5015, ASSE 5021, ASSE 5047, ASSE 5048, ASSE 5052, ASSE 5056, CSA B64.10 or CSA B64.10.1.

## SECTION 313 EQUIPMENT EFFICIENCIES

**313.1 General.** Equipment efficiencies shall be in accordance with the *International Energy Conservation Code*.



## Part VII—Plumbing

### CHAPTER 25 PLUMBING ADMINISTRATION

#### SECTION P2501 GENERAL

**P2501.1 Scope.** The provisions of this chapter shall establish the general administrative requirements applicable to plumbing systems and inspection requirements of this code.

**P2501.2 Application.** In addition to the general administration requirements of Chapter 1, the administrative provisions of this chapter shall also apply to the plumbing requirements of Chapters 25 through 32.

#### SECTION P2502 EXISTING PLUMBING SYSTEMS

**P2502.1 Existing building sewers and drains.** Existing building sewers and drains shall be used in connection with new systems when found by examination and/or test to conform to the requirements prescribed by this document.

**P2502.2 Additions, alterations or repairs.** Additions, alterations, renovations or repairs to any plumbing system shall conform to that required for a new plumbing system without requiring the existing plumbing system to comply with all the requirements of this code. Additions, alterations or repairs shall not cause an existing system to become unsafe, insanitary or overloaded.

Minor additions, alterations, renovations and repairs to existing plumbing systems shall be permitted in the same manner and arrangement as in the existing system, provided that such repairs or replacement are not hazardous and are approved.

#### SECTION P2503 INSPECTION AND TESTS

**P2503.1 Inspection required.** New plumbing work and parts of existing systems affected by new work or alterations shall be inspected by the building official to ensure compliance with the requirements of this code.

**P2503.2 Concealment.** A plumbing or drainage system, or part thereof, shall not be covered, concealed or put into use until it has been tested, inspected and approved by the building official.

**P2503.3 Responsibility of permittee.** Test equipment, materials and labor shall be furnished by the permittee.

**P2503.4 Building sewer testing.** The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer and filling the building sewer with water, testing with not less than a 10-foot (3048 mm) head of water and be able to maintain such pressure for 15 minutes.

**P2503.5 DWV systems testing.** Rough and finished plumbing installations shall be tested in accordance with Sections P2503.5.1 and P2503.5.2.

**P2503.5.1 Rough plumbing.** DWV systems shall be tested on completion of the rough piping installation by water or air with no evidence of leakage. Either test shall be applied to the drainage system in its entirety or in sections after rough piping has been installed, as follows:

1. Water test. Each section shall be filled with water to a point not less than 10 feet (3048 mm) above the highest fitting connection in that section, or to the highest point in the completed system. Water shall be held in the section under test for a period of 15 minutes. The system shall prove leak free by visual inspection.
2. Air test. The portion under test shall be maintained at a gauge pressure of 5 pounds per square inch (psi) (34 kPa) or 10 inches of mercury column (34 kPa). This pressure shall be held without introduction of additional air for a period of 15 minutes.

**P2503.5.2 Finished plumbing.** After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas tight and/or water tight as follows:

1. Water tightness. Each fixture shall be filled and then drained. Traps and fixture connections shall be proven water tight by visual inspection.
2. Gas tightness. When required by the local administrative authority, a final test for gas tightness of the DWV system shall be made by the smoke or peppermint test as follows:
  - 2.1. Smoke test. Introduce a pungent, thick smoke into the system. When the smoke appears at vent terminals, such terminals shall be sealed and a pressure equivalent to a 1-inch water column (249 Pa) shall be applied and maintained for a test period of not less than 15 minutes.
  - 2.2. Peppermint test. Introduce 2 ounces (59 mL) of oil of peppermint into the system. Add 10 quarts (9464 mL) of hot water and seal all vent terminals. The odor of peppermint shall not be detected at any trap or other point in the system.

**P2503.6 Shower liner test.** Where shower floors and receptors are made water tight by the application of materials required by Section P2709.2, the completed liner installation shall be tested. The pipe from the shower drain shall be plugged water tight for the test. The floor and receptor area shall be filled with