



Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems¹

This standard is issued under the fixed designation F 1412; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

^{e1} NOTE—Supplementary Requirements section was editorially updated in December 2002.

1. Scope

1.1 This specification covers requirements for non-pressure polyolefin pipe and fittings for corrosive waste drainage systems.

1.2 This specification is a companion to the Canadian Standard, CAN/CSA-B181.3.²

1.3 Pipe is produced in Schedule 40 and 80 IPS sizes in two polyolefins, polyethylene (PE) and polypropylene (PP).

1.4 The interchangeability of pipe and fittings made by different manufacturers is not addressed in this specification. Transition fittings for joining pipe and fittings of different manufacturers is provided for in this specification.

1.5 Pipe and fittings are joined by the heat fusion method (D 2657 and F 1290) or by using mechanical joints recommended by the manufacturer.

1.6 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are given for information only.

1.7 The following safety hazards caveat pertains only to the test method, Section 8, of this specification. *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.*

2. Referenced Documents

2.1 ASTM Standards:

D 543 Test Method for Resistance of Plastics to Chemical Reagents³

D 570 Test Method for Water Absorption of Plastics³

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing³

D 1248 Specification for Polyethylene Plastics Molding and Extrusion Materials³

D 1600 Terminology for Abbreviated Terms Relating to Plastics³

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings⁴

D 2321 Practice for Underground Installation of Flexible Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications⁴

D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading⁴

D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)⁴

D 2657 Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings⁴

D 3311 Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns⁴

D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials⁵

D 4101 Specification for Propylene Plastic Injection and Extrusion Materials⁵

F 412 Terminology Relating to Plastic Piping Systems⁴

F 1290 Practice for Electrofusion Joining Polyolefin Pipe and Fittings⁴

F 1498 Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings⁴

2.2 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁶

2.3 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁶

2.4 Canadian Standard:

CAN/CSA-B 181.3 Polyolefin Laboratory Drainage Systems²

2.5 Other Document:

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.63 on DWV.

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² Available from the Canadian Standards Association, 178 Rexdale Boulevard, Rexdale (Toronto), Ontario, Canada M 9W 1R3.

³ *Annual Book of ASTM Standards*, Vol 08.01.

⁴ *Annual Book of ASTM Standards*, Vol 08.04.

⁵ *Annual Book of ASTM Standards*, Vol 08.02.

⁶ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

3. Terminology

3.1 Definitions:

3.1.1 Definitions used in this specification are in accordance with the definitions given in Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

3.1.2 The plumbing terminology used in this specification is in accordance with the definitions given in *Uniform Plumbing Code*, unless otherwise indicated.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *toe-in*—a small reduction of the outside diameter at the cut end of a length of thermoplastic pipe.

4. Classification

4.1 *General*—This specification covers Schedule 40 and 80 polyolefin pipe made from polyethylene or polypropylene in iron pipe sizes.

4.2 This specification also includes molded fittings and in larger sizes (8, 10, 12 in.) fabricated fittings.

5. Materials and Manufacture

5.1 Polyethylene (PE) virgin material for pipe or fittings shall be from a single compound manufacturer and shall be made from PE material that meets or exceeds the cell-classification requirements of 112110, 213330 or 324430 as defined in Specification D 3350.

5.1.1 This specification covers PE pipe made from PE plastics as defined by hydrostatic design stresses developed on the basis of long-term tests.

5.2 Polypropylene (PP) virgin material for pipe or fittings shall meet the requirements for polypropylene Group 01, 02 or 03, as defined in Specification D 4101.

5.3 The polyolefin material shall contain suitable stabilizers and antioxidants and may contain pigments and fillers not detrimental to pipe and fittings provided the pipe and fittings produced meet the requirements of this specification.

5.3.1 Polyolefin material can be produced in both regular and flame-retardant compounds for pipe and fittings.

5.4 *Rework Material*—Clean rework material generated from the manufacturer’s own pipe or fitting products may be used by the same manufacturer, using the same type and grade resin, provided that the pipe or fittings produced meet the requirements of this specification.

6. Requirements

6.1 Dimensions and Tolerances—Pipe:

6.1.1 Dimensions and tolerances for pipe shown in Table 1 and Table 2 shall be measured in accordance with Test Method D 2122. The tolerance for out-of-roundness shall apply only to pipe prior to shipment.

6.1.2 *Toe-In*—The outside diameter when measured in accordance with Test Method D 2122 shall meet the requirements of Table 1 and Table 2 when measured at any point within 1.5

TABLE 1 Outside Diameters and Tolerances for Polyolefin Pipe Schedules 40 and 80, in. (mm)

Nominal Pipe Size	Average Outside Diameter	Tolerance	Out-of-Roundness (maximum minus minimum)
1¼	1.660 (42.16)	±0.005 (±0.13)	0.050 (1.27)
1½ ^A	1.750 (44.45)	±0.010 (±0.25)	0.060 (1.52)
1½	1.900 (48.26)	±0.006 (±0.15)	0.060 (1.52)
2	2.375 (60.32)	±0.006 (±0.15)	0.070 (1.78)
3	3.500 (88.90)	±0.008 (±0.20)	0.080 (2.03)
4	4.500 (114.30)	±0.009 (±0.23)	0.100 (2.54)
6	6.625 (168.28)	±0.011 (±0.28)	0.100 (2.54)
8	8.625 (219.08)	±0.015 (±0.38)	0.150 (3.81)
10	10.750 (273.05)	±0.015 (±0.38)	0.150 (3.81)
12	12.750 (323.85)	±0.015 (±0.38)	0.150 (3.81)

^ANot an IPS size. Pipe shall be used with compatible fittings designed for this outside diameter. The wall thickness is the same as 1 1/2 in. IPS Schedule 40 shown in Table 2.

TABLE 2 Wall Thickness and Tolerances for Polyolefin Pipe Schedules 40 and 80, in. (mm)

NOTE 1— For fittings, the wall thickness is a minimum value, except that a 10 % variation resulting from core shift is allowable. In such a case, the average of the two opposite wall thicknesses shall equal or exceed the value shown in the Schedule 40 table.

Nominal Pipe Size	Schedule 40		Schedule 80	
	Minimum	Tolerance	Minimum	Tolerance
1¼	0.140 (3.56)	+0.020 (+0.51)	0.191 (4.85)	+0.023 (+0.58)
1½	0.145 (3.68)	+0.020 (+0.51)	0.200 (5.08)	+0.024 (+0.61)
2	0.154 (3.91)	+0.020 (+0.51)	0.218 (5.54)	+0.026 (+0.66)
3	0.216 (5.49)	+0.026 (+0.66)	0.300 (7.62)	+0.036 (+0.91)
4	0.237 (6.02)	+0.028 (+0.71)	0.337 (8.56)	+0.040 (+1.02)
6	0.280 (7.11)	+0.034 (+0.86)	0.432 (10.97)	+0.052 (+1.32)
8	0.322 (8.18)	+0.039 (+0.99)	0.500 (12.70)	+0.060 (+1.52)
10	0.365 (9.27)	+0.044 (+1.12)	0.593 (15.06)	+0.071 (+1.80)
12	0.406 (10.31)	+0.049 (+1.24)	0.687 (17.45)	+0.082 (+2.08)

pipe diameters or 11.8 in. (300 mm), whichever is less, to the cut end of the pipe length.

6.2 Dimensions and Tolerances—Fittings.

6.2.1 The minimum wall thickness of the body of all fittings shall not be less than the corresponding Schedule 40 pipe size and shall be measured in accordance with Test Method D 2122.

6.2.2 Spigot ends of fittings shall conform to the diameter and out-of-roundness requirements for pipe.

6.2.3 Socket ends of fittings shall conform to the dimensional requirements for size and tolerances as provided on request by the manufacturer.

6.2.4 The average minimum diameters of waterways of fittings excluding adapters shall be as specified in Table 3.

TABLE 3 Average Waterway Diameter, in. (mm)

Nominal Pipe Size	Unthreaded Fittings, min	Threaded Male Adapters	
		Min	Max
1¼	1.227 (31.17)	1.220 (31.00)	1.280 (32.50)
1½	1.446 (36.73)	1.458 (37.00)	1.501 (38.10)
2	1.881 (47.78)	1.915 (48.60)	1.946 (49.40)
3	2.820 (71.63)	2.849 (72.30)	2.983 (75.70)
4	3.737 (94.92)	3.806 (96.60)	3.972 (100.80)
6	5.646 (143.41)	5.851 (148.50)	6.005 (152.40)
8	7.490 (190.25)
10	9.407 (238.94)
12	11.197 (284.40)

⁷ Available from the International Association of Plumbing and Mechanical Officials, 20001 Walnut Drive South, Walnut, CA 91789-2825.

6.2.5 For all fittings having taper pipe threads, threads shall conform to Specification F 1498 and be gaged in accordance with 8.7.

6.2.6 The patterns, dimensions, and laying lengths of molded fittings, including adaptors, shall meet the requirements of Specification D 3311 or shall be of a proven design and shall allow a smooth transition of fluid flow from one direction to another. Specialty fittings or fittings with laying lengths exceeding those shown in D 3311 shall not be excluded. For these fittings, laying lengths shall be provided by the manufacturer.

6.2.7 *Cleanouts*—All polyolefin fitting cleanouts having female threads shall be supplied with polyolefin plugs to suit.

6.2.8 Cleanouts, cleanout plugs, and caps, as commonly used in the manufacturer's laboratory drainage system, shall have a thread size and depth sufficient to ensure that the minimum waterway sizes are maintained.

6.2.9 *Traps*—All traps shall have a minimum water seal of 2 in. (50 mm).

6.3 *Chemical Resistance*—Pipe and fitting materials shall be evaluated in accordance with Test Method D 543, Procedures I and II, using the chemicals listed in 8.3. The weight change shall not exceed 2 % nor shall apparent tensile strength change by more than 10 %. In cases where there is a change in the apparent tensile strength greater than 10 %, a further evaluation shall be made after removal from the chemical, and conditioning for 72 h. If after 72 h there is a minimum of 50 % recovery of tensile strength as compared to the unexposed specimen, and that figure is within $\pm 10\%$ of the original tensile strength of the unexposed specimen shall be considered acceptable.

6.4 *Water Absorption*—Pipe and fitting materials shall not change in weight more than 0.50 % when tested in accordance with 8.4.

6.5 *System Integrity:*

6.5.1 Fused joints and pipe associated with them shall withstand a pressure of 50 psi (0.35 MPa) without leaking when tested in accordance with 8.5.1.

6.5.2 Mechanical joints shall withstand a pressure of 14.5 psi (0.10 MPa) without leaking when tested in accordance with 8.5.2.

NOTE 1—Mechanical joints include transition, compression, threaded, and other mechanical type joints.

6.5.3 Mechanical joints shall incorporate a positive mechanical system for axial restraint in addition to any restraint provided by friction.

6.5.4 Mechanical joints shall show no evidence of separation at the joint under force *P* when tested in accordance with 8.6.1 nor shall they leak or show any other damage when tested in accordance with 8.6.2. Two fittings shall be tested and both shall pass.

6.6 All stainless steel internal grab rings shall be manufactured from corrosion-resistant steel containing not less than 16 % chromium and not less than 6 % nickel by weight.

6.7 *Sealing Rings*—Polyethylene sealing rings shall be of a Type 1 (LDPE) compound.

6.8 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 8.8.

6.9 *Impact Resistance*—The impact resistance testing shall be in accordance with 8.9.

7. Workmanship, Finish, and Appearance

7.1 The manufacture of fittings and pipe shall be in accordance with good commercial practice so as to produce fittings meeting the requirements of this specification. Fittings and pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or injurious defects. The fittings and pipe shall be as uniform as commercially practicable in opacity, density, and other physical properties.

8. Test Methods

8.1 *Conditioning*—Condition the test specimens at $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{F}$) and $50 \pm 5\%$ relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618, for those tests where conditioning is required.

8.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity, unless otherwise specified in the test methods or in this specification.

8.3 *Chemical Resistance*—Determine the resistance to the following chemicals using the test method detailed in Test Method D 543.

Chemical	Percent in Water
Acetic acid	5 by volume
Acetone	100
Methyl alcohol	100
Ammonium hydroxide	10 by volume
Nitric acid	40 by volume
Sodium hydroxide	10 by weight

8.4 *Water Absorption*—Weigh three cleanly cut specimens having smooth edges to the nearest 0.001 g and immerse in distilled water at $73.4 \pm 1.8^\circ\text{F}$ ($23 \pm 1^\circ\text{C}$) for 24 h + $\frac{1}{2}$ –0 h, in accordance with Test Method D 570. Remove the specimens, wipe dry with a clean, dry cloth, and reweigh immediately. Calculate the average percent gain in weight to the nearest 0.01 % on the basis of the initial weight.

8.5 *Hydrostatic Pressure Tests:*

8.5.1 *Fused-Joint Pressure Test*—Select at random six specimens of pipe, each five times the nominal diameter or a maximum of 18 in. (450 mm) in length, for each size of piping and each type of system being considered. Also select three suitable couplings at random. Prepare three joined specimens by joining two pipe specimens with one coupling, using the fusion equipment and instructions supplied by the manufacturer of the system. Fill each specimen with water at $73.4 \pm 3.6^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and cap, taking care to exclude all air from the system. Fix one end of the specimen to a pressurizing apparatus, and support the free end if necessary. Pressurize each specimen to 50 psi (0.35 MPa) for a minimum of 5 min and inspect for leaks. None of the three specimens shall leak (laboratory performance test only, not for field use).

8.5.2 *Mechanical Joint Pressure Test*— Perform the pressure test on mechanical joints on test specimens prepared in a manner similar to that described in 8.5.1, except use appropriate pipe specimens where the joint is intended to join pipes of

similar or dissimilar material and sizes. Pressurize the assembly to 14.5 psi (0.10 MPa) for a period of 24 h + 15, – 0.0 min and inspect for signs of leakage. Apply this test to each size and type of joint being considered (laboratory performance test only, not for field use).

8.6 *Mechanical-Joint Pullout Test:*

8.6.1 Join two sections of pipe by a coupling with the positive mechanical axial restraint system removed or deactivated. Mount the assembly with the outer ends of the pipe sections fastened in the clamps of a tensile testing machine. Pull the two pipe sections apart at a rate of approximately 1 in./min (25 mm/min) until at least one pipe section has separated from the coupling. Record the maximum force *F* applied.

8.6.2 Using the set-up described above, subject a complete joint assembled in accordance with the manufacturer's instructions to an axial pullout force *P* of 25 lbf (110 N) greater than force *F*. In no case shall this force *P* be less than 50 lbf (220 N). Apply force *P* within 5 to 30 s and maintain for at least 60 s.

8.6.3 Remove the axial force and pressurize the complete joint assembly to 14.5 psi (0.10 MPa) hydrostatic pressure for a period of 1 h and inspect for leaks.

8.7 *Threads*—All taper pipe threads shall be gaged in accordance with Specification F 1498.

8.8 *Flattening*—Using Test Method D 2412, flatten three specimens of pipe 6-in. (152-mm) long, between parallel plates in a suitable press until the distance between the plates is 40 % of the original outside diameter of the pipe. The rate of vertical displacement shall be uniform and such that the flattening is completed within 2 to 5 min. On removal of the load, examine the specimens for evidence of splitting, cracking, or breaking.

8.9 *Impact Resistance:*

8.9.1 *Polyolefin Pipe and Fittings*—Determine and test polyolefin pipe and fitting impact values in accordance with Test Method D 2444, using Tup A. The level of impact shall be in accordance with data provided by the manufacturer, which shall show impact values for each size at 73°F (23°C) that specifies adequate quality consistent with the polyolefin compound used by that manufacturer. Test 10 specimens. When 9 or 10 specimens pass, accept the lot. When 4 or more specimens fail, reject the lot. When 2 or 3 specimens of 10 fail, test 10 additional specimens. When 17 of 20 specimens tested pass, accept the lot. When 7 or more of 20 fail, reject the lot. When 4, 5 or 6 of 20 fail, test 20 additional specimens. When 32 of 40 specimens pass, accept the lot. When 9 or more of 40 specimens fail, reject the lot. Failure in the test specimens shall be shattering or any crack or break extending entirely through the pipe wall visible to the unaided eye.

NOTE 2—This test is intended only for use as a quality control test, not as a simulated service test.

9. Retest and Rejection

9.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) may be conducted again in

accordance with an agreement between the purchaser and the seller. There shall be no agreement to lower the minimum requirement of the specification by such means as omitting tests that are a part of the specification, substituting or modifying a test method, or by changing the specification limits. In retesting, the product requirements of this specification shall be followed. If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirement of this specification.

10. Product Marking

10.1 *Quality of Marking*—The markings shall be applied to the fittings and pipe in such a manner that they remain legible under normal handling and installation practices.

10.2 *Content of Marking:*

10.2.1 Fittings shall be marked with the following:

10.2.1.1 Manufacturer's name or trademark.

10.2.1.2 Raw material designation and type in accordance with 5.1 or 5.2. Flame-retardant material shall be designated "FR". For example, flame-retardant polypropylene shall be marked "PPFR 110" or "FRPP 110".

10.2.1.3 If listed, the seal or mark of the laboratory making the evaluation for corrosive waste application.

10.2.1.4 Size.

10.2.1.5 This designation "F 1412", with which the fitting complies.

10.2.2 Marking on the pipe shall include the following, spaced at intervals of not more than 5 ft (1.5 m):

10.2.2.1 Manufacturer's name or trademark,

10.2.2.2 Raw material and designation and type, in accordance with 5.1 or 5.2. Flame-retardant material shall be designated "FR". For example, flame-retardant polypropylene shall be marked "PPFR 110" or "FRPP 110".

10.2.2.3 If listed, the seal or mark of the laboratory making the evaluation for corrosive waste application,

10.2.2.4 Nominal pipe size (for example, 2 in.),

10.2.2.5 This designation "F 1412", with which the fitting complies.

10.2.2.6 Schedule size (40 or 80, whichever is applicable).

NOTE 3—Pressure pipe may be used for drainage.

11. Quality Assurance

11.1 When the product is marked with this designation, F 1412, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

12. Keywords

12.1 acid waste; corrosion resistance; corrosive waste; drainage; drain pipes; installation; joints; laboratory piped services; pipe fittings; pipes; plastic pipes; polyethylene; polyolefin; polypropylene; thermoplastic polymers; traps (drainage); waste disposal (building)

SUPPLEMENTARY REQUIREMENTS**GOVERNMENT/MILITARY PROCUREMENT**

These requirements apply *only* to Federal/Military Procurement, not domestic sales or transfers.

S1. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1.1—In U.S. federal contracts, the contractor is responsible for inspection.

S2. *Packaging and Marking for U.S. Government Procurement*:

S2.1 *Packaging*—Unless otherwise specified in the contract, the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S2.2 *Marking*—Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S2.1—The inclusion of the U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

ANNEX**(Mandatory Information)****A1. INSTRUCTIONS**

A1.1 The manufacturer shall ensure that equipment and instructions needed for joining the pipe and fittings are readily obtainable by the installer.

A1.2 Polyolefin drainage systems shall be installed and supported in accordance with the manufacturer's recommendations.

APPENDIXES**(Nonmandatory Information)****X1. STORAGE**

X1.1 *Outside Storage*—Plastic pipe should be stored on a flat surface or supported in a manner that will prevent sagging or bending. Do not store pipe in direct sunlight for long periods.

X1.2 Inventories of plastic pipe should be used first-in, first-out basis.

X2. JOINING

X2.1 *Field Inspection*—Prior to use, all pipes should be carefully inspected for cuts, gouges, deep scratches, damaged ends, or other major imperfections. Defective pipe should be rejected or the damaged sections should be cut out.

X2.3 Caution must be taken if there is an excess amount of toe-in. This could result in excess clearance and, if not cut off, result in a poorly fused joint.

X2.2 *Pipe Fit*—Pipe is manufactured to close tolerances to ensure satisfactory fit between the pipe and the fittings socket during assembly. Use only combinations of pipe and fittings that yield manufacturer recommended fits.

X2.4 *Cutting*—Pipe can be easily cut with ordinary saws. The pipe should be cut square and all burrs removed with a sharp knife, fine tooth file, or other suitable tool such as chamfering tool or reamer. A miter box is recommended to ensure square cut ends. The use of specially designed plastic

pipe cutters with extra wide rollers and thin cutting wheels is recommended.

X2.5 *Cleaning*—Remove burrs from inside and outside

pipe edges. Wipe off all dust, dirt, and moisture from surfaces to be joined with a clean dry rag or a paper towel. Pipe and fittings must be dry before assembly to obtain good joints.

X3. INSTALLATION

X3.1 *Underground Installation*—Underground installations of pipe shall be in accordance with Practice D 2321, except aggregate size shall be limited to ½ in. (13 mm) for angular and ¾ in. (19 mm) for rounded particles. Non-flame retardant pipe is generally used in underground applications.

X3.2 *Above-Ground Installation*—Flame-retardant pipe and fittings are used in applications where the burning rate is an important consideration.

X3.3 *DWV Installation*—Pipe should be installed in conformance with governing building codes. In areas not governed by codes, pipe should be installed in accordance with accepted engineering practices.

X3.4 *Installation Under Freezing Conditions*—Plastic pipe has decreased resistance to impact under freezing conditions. Increased care should be exercised if installation is likely to occur under these conditions, particularly during handling, transportation, installation, and backfilling. When possible, installation should be avoided during freezing conditions. Allowance shall be made for expansion that will occur when the temperature of the pipe is raised.

X3.5 *Alignment and Grade*—Align all piping system components properly without strain. Do not bend or pull pipe into position after being joined. The grade of horizontal drainage and vent piping shall be as specified in the application code.

X3.6 *Supports and Spacing*—Hangers and straps should not compress, distort, cut, or abrade the piping and should allow free movement of pipe. Support horizontal piping in accordance with the manufacturer’s recommendations. Supports should allow free movement. Maintain vertical piping in

straight alignment with supports at each floor level or at 10-ft (3.1-m) intervals, whichever is less.

X3.7 *Threaded Connections*—Do not cut threads on pipe. Molded threads on adapter fittings for transition to threaded construction are necessary except in the case of cleanout plugs. Only approved thread tape or thread lubricant specifically intended for use with plastic pipe should be used.

X3.8 *Thread Tightness*—Maximum thread tightness is hand tight plus one full turn.

X3.9 *Connection to Nonplastic Pipe*—When connecting plastic pipe to other types of piping, use only approved types of fittings and adapters designed for the specific transition.

X3.10 *Building Drains Under Floor Slabs*—Trench bottoms should be smooth and of uniform grade with either undisturbed soil or a layer of selected and compacted backfill so that no settlement will occur. Bottom of pipe must rest on this material throughout the entire length.

X3.11 *Thermal Expansion*—Allow for thermal expansion and movement in all piping installations by the use of approved methods. Support, but do not rigidly restrain piping at branches or changes of direction. Do not anchor pipe rigidly in walls. For thermal expansion consult the manufacturer.

X3.12 *Chemical Resistance*—Before installing a polyolefin corrosive waste piping system, chemical resistance data for the piping in question should be consulted. Caution should be taken when mixing chemicals as properties can change. If there is a chemical resistance question, consult the manufacturer.

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