Designation: D2949 – 10

Standard Specification for 3.25-in. Outside Diameter Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings[1]

This standard is issued under the fixed designation D2949; 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.

1. Scope*

1.1 This specification covers requirements and test methods for materials, dimensions and tolerances, deflection load, crush resistance, flattening resistance, impact resistance, and solvent cement. A form of marking is also included. Plastic which does not meet the material requirements specified in Section 5 is excluded.

NOTE 1—This specification was formerly issued under the title, 3-in. Thin Wall Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

NOTE 2—Techniques for making solvent-cement joints are given in Practice D2855.

1.2 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.3 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.

1.4 The following precautionary caveat pertains only to the test methods portion, Section 7, 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:*[2]

D618 Practice for Conditioning Plastics for Testing

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2152 Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion

D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D2564 Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

D3311 Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns

F402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

F412 Terminology Relating to Plastic Piping Systems

F1498 Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

4. Significance and Use

4.1 The requirements of this specification are intended to provide pipe and fittings suitable for drainage of sewage and certain other liquid wastes where toughness, resistance to deterioration from water and chemicals, flattening and aging resistance, and strong tight joints are required.

4.2 When joining 3.25-in. outside diameter PVC DWV piping to 3-in. Schedule 40 PVC DWV piping, it is necessary to use either reducer bushings or increasers, as shown in the tables at the end of the text, due to the differences in pipe outside diameters.

[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] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

NOTE 3—Industrial waste disposal lines should be installed only with the specific approval of the cognizant building code authority since chemicals not commonly found in drains and sewers, and temperatures in excess of 160°F (70°C), may be encountered.

5. Materials

5.1 *Basic Materials*—Pipe and fittings shall be made from virgin poly (vinyl chloride) compounds meeting the requirements of Class 12454, as defined and described in Specification D1784.

5.2 *Rework Material*—The manufacturer shall use only his own clean pipe or fitting rework material and the pipe or fitting produced shall meet all the requirements of this specification.

5.3 *Solvent Cement*—The solvent cement shall meet the requirements of Specification D2564.

6. Requirements

6.1 *General*—The pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

6.1.1 The requirements in this section are intended only for use as quality control tests, not as simulated service tests.

6.2 *Dimensions and Tolerances*—All dimensions shall be measured in accordance with Test Method D2122. All tolerances shall meet the requirements of Tables 1-11 unless otherwise specified.

6.2.1 *Pipe:*

6.2.1.1 *Pipe Dimensions*—The outside diameters and wall thicknesses of the pipe shall meet the requirements of Table 1.

6.2.1.2 *Pipe Length*—The pipe shall be in either 10 or 20-ft or 3 or 6-m lengths, unless otherwise specified with allowable tolerance of +½ in., 0 in. or +13 mm, −0 mm.

6.2.2 *Fittings:*

6.2.2.1 *Fittings-Socket Dimensions*—The socket dimensions of fittings shall meet the requirements given in Table 2.

6.2.2.2 *Fittings Laying Length Dimensions*—The laying length dimensions of fittings, shall conform to the requirements given in Table 3 through Table 11.

6.2.2.3 *Transition Adapters*—The dimensions of adapters for connecting plastic pipe to cast iron hubs shall conform to the dimensions given in Table 4.

6.2.2.4 *Fittings Dimensions*—The dimensions of fittings covered by this specification shall meet the requirements given in Table 3 through Table 11.

NOTE 4—Additional fittings in IPS dimensions are included in Specification D3311.

6.3 *Deflection Load and Crush Resistance:*

6.3.1 *Pipe*—The pipe shall support a minimum load of 600 lbf/linear ft (810 N/m) at 15 % deflection of the original diameter (deflection load), and shall deflect 60 % of the original diameter (crush resistance) without cracking, rupture, or other visible evidence of failure when tested in accordance with 7.4. The minimum pipe stiffness at 5 % deflection shall be 115 lbf/in.·in. (800 kPa).

6.3.2 *Fittings*—Individual fittings unassembled shall withstand a minimum load of 1000 lbf/ft (1350 N/m) of centerline length without cracking or other visible evidence of failure when tested in accordance with 7.4. This requirement does not apply to inline fittings.

6.4 *Flattening Resistance*—The average decrease in inside diameters of pipe and fittings shall not exceed 10 % when tested in accordance with 7.5 (Note 3).

6.5 *Impact Resistance*—The minimum impact resistance, when tested at the time of manufacture, shall be 50 ft·lbf (67.79 J) at 73°F (23°C) for pipe and 20 ft·lbf (27.12 J) at 73°F for fittings. Test in accordance with Test Method D2444 using Tup C and Holder A for pipe and Tup A and Holder B for fittings. Use a 12-lb (5-kg) tup for testing pipe and fittings. Test couplings cemented to short pieces of pipe and allowed to dry for 24 h.

6.5.1 Test 10 specimens. When 9 or 10 specimens pass, accept the lot. When 2 or more specimens fail, test 10 additional specimens. When 17 of 20 specimens tested pass, accept the lot. When 4 or more of 20 specimens fail, test 20 additional specimens. When 32 of 40 specimens pass, accept the lot. When 9 or more of 40 specimens fail, the lot does not meet the requirements of this specification.

6.5.2 Failure of the test specimen shall be shattering or any crack or break extending entirely through the pipe wall and visible to the unaided eye.

6.6 *Threads*—For all fittings having taper pipe threads, threads shall conform to Specification F1498 and be gaged in accordance with 7.6.

6.7 *Extrusion Quality*—The pipe shall not flake or disintegrate when tested in accordance with Test Method D2152.

7. Test Methods

7.1 *Sampling*—Take a random sample from each lot or shipment of the pipe and fittings sufficient to determine conformance with this specification. About 40 ft (12 m) of pipe are required to make the tests prescribed. The number of fittings required varies depending on the size and type of fitting.

7.2 *Conditioning:*

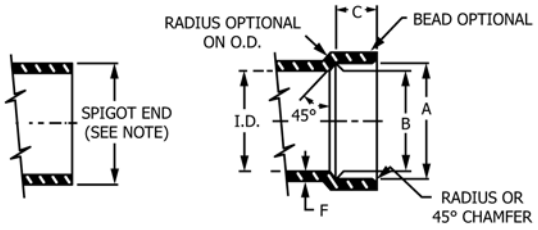
TABLE 1 Dimensions and Tolerances for Outside Diameters and Thicknesses of PVC 3.25-in. Outside Diameter Plastic Drain, Waste, and Vent Pipe, in. (mm)

Nominal Pipe Size, in.	Outside Diameter			Wall Thickness[A]	
	Average	Tolerance on Average	Out-of-Roundness (maximum minus minimum)	Min	Tolerance
3.25	3.250 (82.56)	±0.008 (±0.20)	0.030 (0.76)	0.125 (3.18)	+0.020 (+0.50)

[A] The minimum is the lowest wall thickness of the pipe at any cross section. The maximum permitted wall thickness, at any cross section, is the minimum wall thickness plus the stated tolerance.

TABLE 2 Dimensions and Tolerances for Fitting Sockets for 3.25-in. Outside Diameter PVC Plastic Drain, Waste, and Vent Pipe Fittings, in. (mm)

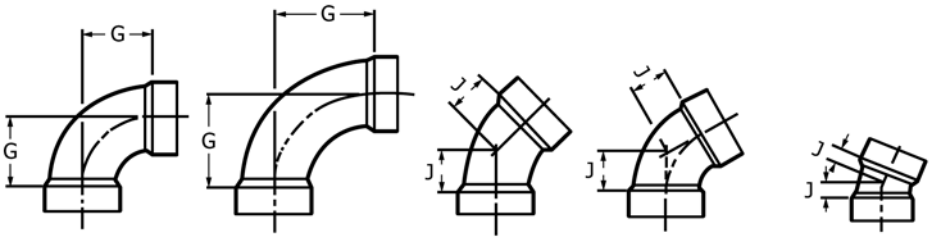
NOTE 1—Spigot ends shall conform to the outside diameters and tolerances for pipe of the same size



Nominal Pipe Size, in.	*A* Socket Entrance Diameter		*B* Socket Bottom Diameter		*C* Spigot and Socket Depth	*D* Wall Thickness
	avg[A]	*Tm*[B]	avg[C]	*Tm*[B]	min	min[D,E]
3.25	3.265 (82.94)	±0.008 (±0.20)	3.245 (82.42)	±0.008 (±0.20)	1½ (38)	0.140 (3.56)

[A] The tolerances on this average are +0.010 to –0.005 in. (+0.25 to –0.13 mm).
[B] *Tm* = permissible deviation of diameter from measured average, often called out-of-roundness.
[C] Tolerance on average +0.005 in., –0.010 in. (+0.13 mm, –0.25 mm).
[D] Minimum wall thickness in the socket is 0.125 in.
[E] 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 table.

TABLE 3 3.25-in. Outside Diameter Bends, in. (mm)



Nominal Pipe Size, in.	¼ Bend *G*, min	Long-Sweep ¼ Bend *G*, min	⅛ Bend *J*, min	⅙ Bend *J*, min	1⁄16 Bend *J*, min
3.25	2⅞ (73)	4 (101.6)	1 (25.4)	1¼ (31.8)	⅝ (15.88)

7.2.1 For referee testing at 73°F, condition the specimens prior to test at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity in accordance with Practice D618, Procedure A.

7.2.2 For routine quality control testing at 73°F, condition the specimens at the temperature and humidity of the manufacturers testing facility for not less than 1 h or until the specimens are at the room temperature.

7.3 *Test Conditions:*

7.3.1 For referee purposes, conduct tests in the standard laboratory atmosphere of 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity.

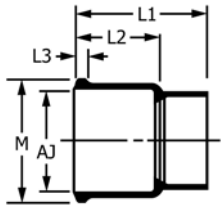
7.3.2 For routine quality control testing, conduct tests at the temperature and humidity of the manufacturers testing area.

7.4 *Deflection Load and Crush Resistance*—Measure the deflection load and crush resistance of pipe and fittings in accordance with Test Method D2412. In the test for pipe note the load when the initial inside diameter is reduced by 5 % (pipe stiffness), by 15 % (deflection load), and continue the test until the diameter is reduced by 60 % of its original value (crush resistance). The rate of head approach shall be 0.20 to 0.25 in./min (5.1 to 6.4 mm/min). Each specimen shall meet the requirements of 6.3.1.

7.4.1 *Fitting Test Specimens*—Test three complete fittings. Shim fittings to give full centerline contact with platens. Fittings having nonuniform diameters such as reducers shall be considered acceptable when the wall thickness at all points is equal to or greater than the wall thickness of pipe of the same material and diameter that meets the crush resistance requirements. Each specimen shall meet the requirements of 6.3.2.

7.4.2 *Procedure*—Terminate the test when the inside diameter of pipe test specimens is reduced to 40 % of its original value or the pipe cracks or shows other visible evidence of failure. Terminate the test on fittings when the load reaches 1000 lbf/ft (1350 N/m) of centerline length. Observe the load and deflection at the first evidence of cracking, if any. Record location and type of failure.

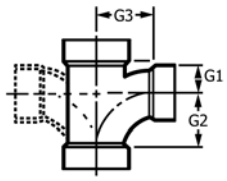
TABLE 4 3.25-in. Outside Diameter Reducing Spigots, in. (mm)



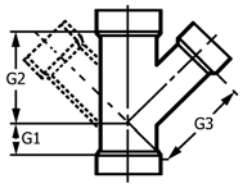
**PLASTIC SPIGOT, Reducing
Adapts Cast Iron Hub
to Plastic Pipe**

Nominal Pipe Size, in.	L_2, min	L_1, min	L_3, min	*M*		*AJ*, Nominal
				max	min	
3.25 by 4-in. Cast Iron	3⅞ (98.4)	5⅝ (142.9)	⅜ (9.5)	4⁹⁄₁₆ (115.9)	4½ (114.3)	3⅞ (98.4)

TABLE 5 3.25-in. Outside Diameter Reducing Sanitary Tee and 45° Wyes, in. (mm)



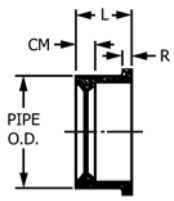
SANITARY TEE, Reducing
Single & Double



45° WYE, Reducing
Single & Double

Nominal Pipe Size, in.	Sanitary Tee Reducing			45° Wye Reducing Single and Double		
	G_1, min	G_2, min	G_3, min	G_1, min	G_2, min	G_3, min
3.25 by 3.25 by 1½-in. IPS	¹⁵⁄₁₆ (23.8)	1¾ (44.5)	2³⁄₁₆ (55.6)	⅜ (9.5)	3¼ (82.5)	3¹⁷⁄₃₂ (89.7)
3.25 by 3.25 by 2-in. IPS	1⅜ (34.9)	2 (50.8)	2¼ (57.2)	⅜ (9.5)	3¼ (82.5)	3¹¹⁄₁₆ (93.6)

TABLE 6 3.25-in. Outside Diameter Bushings in. (mm)



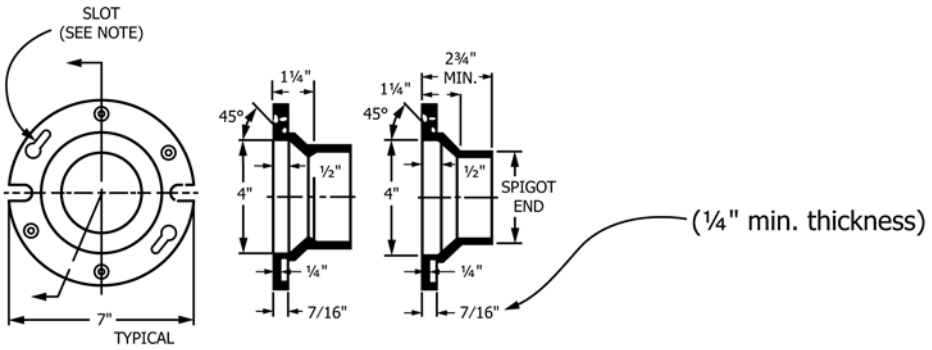
**BUSHING
Style 1**

Nominal Pipe Size, in.	Style 1		
	L, min	*CM*, min	*R*, min
3.25 by 1½-in. IPS	1⅞ (47.6)	1⅛ (28.6)	⅜ (9.5)
3.25 by 2-in. IPS	1⅞ (47.6)	1 (25.4)	⅜ (9.5)
3.25 by 3-in. IPS	1¾ (44.5)	¼ (6.4)	0 (0)

7.4.3 *Calculation*—For pipe, divide the load in pounds-force or newtons at 15 % deflection (deflection load) and also at failure (crush resistance), if such occurred, by the length of the pipe test specimen in feet or metres to obtain the deflection load and crush resistance, respectively, in pounds per linear foot, or newtons per metre. For pipe stiffness, divide the load in pounds-force or newtons at 5 % deflection by the specimen length in inches or metres and then divide by the deflection in

TABLE 7 4-in. by 3.25-in. Outside Diameter Reducing Closet Ring

NOTE 1—Slot is optional if fully reinforced with a corrosion-resistant material.

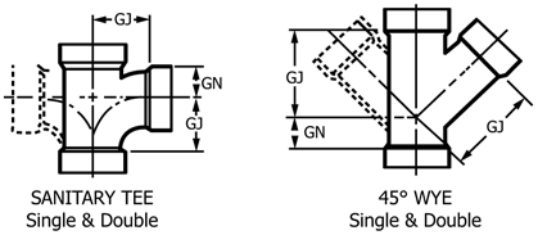


4″ × 3″ REDUCING CLOSET RING

Closet Flange, in. (mm)[A]	
in.	mm
7	(180)
4	(101.5)
2¾	(70)
1¼	(32)
½	(13)
7/16	(11)
¼	(6.5)

[A] Tolerance ±1/16 in. or ±1.6 mm.

TABLE 8 3.25-in. Outside Diameter Sanitary Tees—45° Wyes, in. (mm)



Nominal Pipe Size, in.	Sanitary Tee Single and Double, min		45° Wye Single and Double, min	
	GN	*GJ*	*GN*	*GJ*
3.25	1 7/16 (36.5)	2 15/16 (74.6)	¾ (19.0)	4⅛ (104.8)

inches or metres. Calculate the values for each specimen separately. Examine the test results for each specimen for conformance to the requirements of 6.3.1 and 6.3.2.

7.5 *Flattening Resistance*—Cut cleanly four pipe test specimens, each 6 in. (150 mm) in length. The fitting specimens shall consist of four complete fittings. Mark and measure a diameter on the inside to the nearest 0.001 in. (0.02 mm). Place the specimens on a flat-rigid base with the measured diameter in a vertical position and place the assembly in a circulating air oven. Load pairs of test specimens symmetrically by means of a rigid plate with a total load of 55 lb (25 kg), and place in the oven maintained at 122 ± 5.4°F (50 ± 3°C) for 40 ± 1 h. Unload the specimens and remove from the oven. After cooling for 1 h, remeasure the marked and measured inside diameters, and calculate the average change in percent of the initial inside diameter. Examine the results for conformance to the requirements of 6.4.

7.6 *Threads*—All taper pipe threads shall be gaged in accordance with Specification F1498.

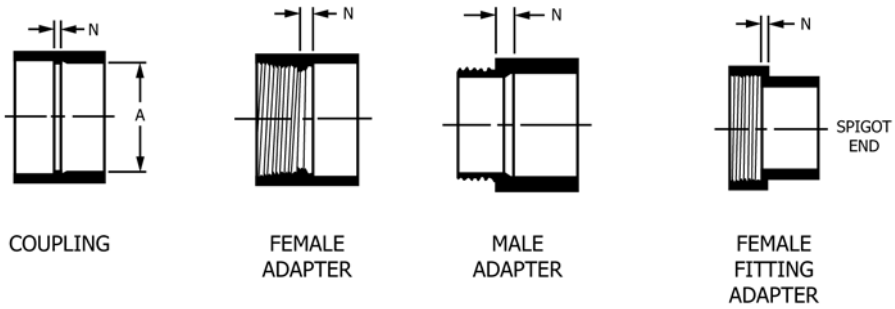
8. Retest and Rejection

8.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again only by agreement between the purchaser and seller. Under such agreement, minimum requirements shall not be lowered, changed, or modified, nor shall specification limits be changed. If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

9. Marking

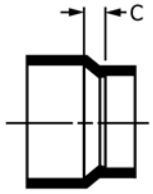
9.1 *Pipe*—The pipe shall be marked in letters not less than 3/16 in. (5 mm) high in a contrasting color and shall as a minimum consist of the manufacturer's name or trademark,

TABLE 9 3.25-in. Outside Diameter Couplings and Adapter, in. (mm)



Nominal Pipe Size, in.	Coupling	Female Adapter	Male Adapter	Female Fitting Adapter
	N, min	*N*, min	*N*, min	*N*, min
3.25	3/16 (4.8)	7/16 (11.1)	5/16 (7.9)	1/8 (3.2)

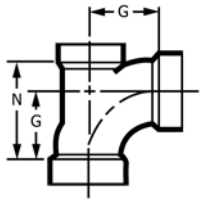
TABLE 10 3.25-in. Outside Diameter Pipe Increasers, in. (mm)



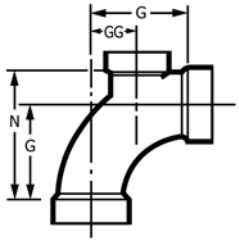
PIPE INCREASER

Nominal Pipe Size, in.	*C*, min
3.25 by 1½-in. IPS	½ (12.7)
3.25 by 2-in. IPS	⅜ (9.5)
3.25 by 3-in. IPS	¾ (19.0)

TABLE 11 3.25-in. Outside Diameter Bends with Inlets, in. (mm)



1/4 BEND
With Low Heel Inlet



LONG SWEEP 1/4 BEND
With High Heel Inlet

Nominal Pipe Size, in.	¼ Bend with Low Heel Inlet, min		Long-Sweep ¼ Bend with High Heel Inlet, min		
	G	*N*	*G*	*N*	*GG*
3.25 by 1¼-in. IPS	2⅞ (73.0)	4 (102)	4 (102)	5 11/16 (144.5)	2½ (63.5)
3.25 by 2-in. IPS	2⅞ (73.0)	4⅛ (104.8)			

3.25-in. OD PVC DWV ASTM D2949, spaced at intervals of not more than 5 ft (1.5 m).

9.2 *Fittings*—All fittings shall be marked on the body or hub. The marking shall as a minimum consist of the manufacturer's name or trademark, and the symbol 3.25-in. OD PVC DWV.

10. Quality Assurance

10.1 When the product is marked with this designation, D2949, 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.

11. Keywords

11.1 3.25 in. O.D.; DWV; fittings; pipe; plastic; PVC; thin-wall

APPENDIX

(Nonmandatory Information)

X1. STORAGE AND INSTALLATION PROCEDURES FOR PVC PLASTIC DRAIN, WASTE, AND VENT PIPING

X1.1 *Storage*—Do not store pipe and fittings in direct sunlight for long periods. Store pipe in such a manner as to prevent sagging or bending. Exposure to sunlight during normal construction periods is not harmful. It is good practice to store pipe and fittings under suitable cover prior to installation.

X1.2 *Visibility of Marking*—Always position pipe and fittings so that identifying markings are readily visible to inspection when installed.

X1.3 *Solvent Cement*—Use solvent cements meeting the requirements of Specification D2564, and packaged in containers suitable for size of pipe being joined. Do not thin the cement. Discard cement that has thickened. Solvent cements are flammable. Keep away from heat, spark, and open flame. Avoid prolonged breathing of vapors. Prolonged contact with skin is harmful. Use with adequate ventilation and avoid contact with eyes and skin. For further information, see Practice F402.

X1.4 *Socket Fit*—The PVC pipe and fittings are manufactured to close tolerances. Close tolerances are required to ensure satisfactory“ interference” fit between the pipe and fitting during the solvent cement joining. Use only pipe and fitting combinations that give interference fits. Pipes that are “loose” when bottomed in a socket may not properly fuse chemically. The allowable tolerances assure a forced fit and when solvent is applied will readily mate, thus assuring a chemical fusion equal in strength to the pipe or fitting. Attempting to correct a loose fit after assembly by additional cement may result in an unsatisfactory joint.

X1.5 *Joining Technique:*

X1.5.1 *Cutting the Pipe*— Cut the pipe square with saws or pipe cutters designed specifically for this material; protect pipe and fittings from serrated holding devices and abrasion.

X1.5.2 *Deburring Pipe*— Remove burrs from inside and outside pipe edges.

X1.5.3 *Cleaning Joining Surfaces* —Wipe off all dust, dirt, and moisture from surfaces to be cemented with a clean, dry rag or paper towel. Remove gloss and any oily film from the pipe and mating socket with clean steel wool, fine abrasive paper, chemical cleaner, or primer. In case of conflicting solvent cementing instructions, the instructions of the cement manufacturer should be followed.

X1.5.4 *Application of Cement*—Use a natural bristle or nylon brush of adequate size (usually at least ½ the pipe diameter) or an applicator supplied with the can of cement. Apply a moderate even coating of cement in the fitting socket, completely covering the pipe joining surfaces only. Heavy or excessive applications of cement may become an obstruction inside the piping. Quickly apply a heavy even coat of cement to the outside of the pipe. Make sure that the coated distance on the pipe is equal to the depth of the fitting socket.

X1.5.5 *Assembly*—Make the joint as quickly as possible after application of the cement and before the cement dries. Insert the pipe into the fitting socket, turning the pipe slightly to ensure even distribution of cement. Make sure that the pipe is inserted to the full depth of the socket. Remove excess solvent cement from the exterior of the joint with a clean, dry cloth. Reasonable handling of the assembly is permissible after 2 min. Do not attempt to disturb the pipe-fitting joint until after the cement has set; damage to the joint and loss of fit may result. Should the cement dry partially before joint is made up, reapply cement before assembly. Allow 15 min for the joint to develop good handling strength.

X1.6 *Joints:*

X1.6.1 *Threaded Connection*—Do not cut threads on PVC drain, waste, and vent pipe. Molded threads are permitted. Use of adapter fittings for transition to threaded construction is necessary except in the case of cleanout plugs. The joint between the PVC pipe and transition fitting should be of the solvent cement type. Only approved thread tape or thread lubricant specifically intended for use with PVC plastic pipe should be used. Conventional pipe thread compounds, putty, linseed oil-base products, and unknown mixtures should be avoided.

X1.6.2 *Connections to Traps*—Connect traps by means of approved threaded trap adapters.

X1.6.3 *Connection to Closet Flanges*—Install screw-type closet flanges in the drainage system by means of a threaded connection. Install caulk-type closet flanges in accordance with the procedure outlined in X1.6.6.

X1.6.4 *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 intended.

X1.6.5 *Thread Tightness*—Where a threaded joint is made, obtain tightness by maximum hand tightening plus additional tightening with a strap wrench not to exceed one full turn.

X1.6.6 *Transition to Bell-and-Spigot Pipe*—Make connections or transitions to bell-and-spigot cast iron soil pipe and fittings, and to bell-and-spigot pipe and fittings of other materials, with approved mechanical compression joints designed for this use, or caulked joints made in an approved manner. In caulking, pack the joint with oakum or hemp and fill with molten lead to a depth of not less than 1 in. (25 mm). Allow a period of 4 min for cooling then, caulk the lead at the inside and outside edges of the joint. Do not overheat lead. Heat lead to melting point only.

X1.7 *Alignment and Grade*—Align all piping system components properly without strain. Do not bend or pull pipe into position after being solvent-welded. Grade of horizontal drainage and vent piping shall be as specified for other materials in the applicable code.

X1.8 *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 at intervals of not more than 4 ft (1.2 m) at end of branches, and at changes of direction or elevation. 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. Support trap arms longer than 3 ft (0.9 m) in length as close as possible to the trap. Securely fasten closet rings to the floor with corrosion-resistant fasteners with top surface ¼ in. (6.4 mm) above the finish floor level. Stabilize the closet bends or stubs against all horizontal or vertical movement. Protect the pipe exposed to damage by sharp surfaces with grommets or sleeves of rubber or plastic.

X1.9 *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. Holes through framing members should be adequately sized to allow for free movement. Thermal expansion for installations subject to temperature changes may be determined from Table X1.1 and Table X1.2. The linear expansion shown is independent of the diameter of the pipe. Buried piping or piping installed in the crawl space under a building is normally subject to less than the ambient temperature change. Do not install piping except vent piping through roofs, so as to be exposed to direct sunlight after installation.

X1.10 *Building Drains Under Floor Slabs*—Make trench bottoms smooth and of uniform grade with either undisturbed soil or a layer of selected and compacted backfill so that no settlement will be encountered. Pipe must bear on this material throughout the entire length of its barrel.

X1.11 *Exposed Piping*—Provide adequate support where piping is exposed to wind, snow, and ice loading. Where surface temperatures exceed 140°F (60°C) piping shall be protected by means of shielding or some type of light weight insulation.

X1.12 *Antifreeze Protection*—When necessary to protect traps and fixtures from freezing do not use petroleum products. Use only approved plastic pipe antifreeze packaged for this purpose or one of the following solutions:

X1.12.1 A 60 weight % of glycerin in water mixed at 73°F (23°C).

X1.12.2 A 22 weight % of magnesium chloride in water. Strong solutions of common table salt (sodium chloride) may also be used.

TABLE X1.1 Thermal Expansion Table for PVC Plastic Pipe and Fittings (Metric)

Length, m	Temperature Change,°C			
	20	30	40	50
	Length of Change, mm			
10	3	4.5	6	7.5
20	6	9	12	15
30	9	13.5	18	22.5

TABLE X1.2 Thermal Expansion Table for PVC Plastic Pipe and Fittings (Inch-pound)

Length, ft	Temperature Change, °F						
	40	50	60	70	80	90	100
	Length of Change, in.						
20	0.28	0.35	0.42	0.49	0.56	0.63	0.70
40	0.56	0.70	0.84	0.97	1.11	1.25	1.39
60	0.84	1.04	1.25	1.46	1.67	1.88	2.09
80	1.13	1.39	1.67	1.95	2.23	2.51	2.78
100	1.39	1.74	2.09	2.44	2.78	3.13	3.48

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (D2949 – 01a$^{\varepsilon 1}$) that may impact the use of this standard.

(1) 1.1 was revised.
(2) Former 6.4 and Note 5 were deleted.
(3) Former 7.5 was deleted.