

**Installation Standard  
For  
PVC BUILDING DRAIN, WASTE AND VENT PIPE AND FITTINGS**

**IAPMO IS 9-2003**

**1.0 SCOPE**

**1.1** This installation standard shall apply to PVC building drain, waste, and vent systems as governed by the Uniform Plumbing Code. Material Standard ASTM D2665, "Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings", shall form part of this installation standard.

**1.2** Installation, material and inspection shall comply with the current edition of the Uniform Plumbing Code [UPC]<sup>TM</sup> published by the International Association of Plumbing and Mechanical Officials and shall also comply with this standard.

**Note:** *The Building Official shall be consulted about penetration of fire separations, height and area, or other limitations.*

**Note:** *The following sections of the Uniform Plumbing Code apply.*



- 218.0 Definition PVC
- 301.1 Minimum Standards
- 311.8 Screwed Fittings
- 310.0 Workmanship
- 311.0 Prohibited Fittings and Practices
- 313.0 Protection of Piping, Materials and Structures
- 314.0 Hangers and Supports
- 316.1.6 Type of Joints – Solvent Cement Plastic Pipe Joints
- 316.2 Special Joints
- 316.3 Flanged Fixture Connections
- 316.4 Prohibited Joints and Connections
- 317.0 Increases and Reducers
- 701.0 Materials (Drainage)

- 704.4 Closet Flanges
- 707.1 Cleanout Fittings
- 903.0 Materials (Venting)
- 903.4 Straining or Bending Pipe
- 1003.0 Traps Described
- 1101.3 Materials Uses
- Table 14-1 Pipe and Fittings
- ASTM D 2665 D 2122
- ASTM D 3311<sup>1</sup>

**ABBREVIATIONS**

- ASTM American Society for Testing and Materials
- IAPMO International Association of Plumbing and Mechanical Officials
- UPC Uniform Plumbing Code

**2.0 PRODUCT REQUIREMENTS**

**2.1 Minimum Standards**

**2.1.1 Pipe.** PVC pipe markings shall be in accordance with D 2665.<sup>2</sup> [UPC 301.1.2]

**2.1.2 Fittings.** PVC fitting markings shall be in accordance with D 2665 or D 3311. [UPC 301.1.2]

**2.1.3 Solvent Cement.** Solvent cement label markings shall be in accordance with D 2564.

**2.1.3.1** Solvent cements shall not be purple in color.

**2.1.4 Primers.** Primer container markings shall be in accordance with F 656.

**2.1.4.1** Primer shall be purple.

**2.2 Workmanship**

**2.2.1 Alignment**

All piping systems components shall be aligned properly without strain. Pipe shall not be bent or pulled into position. Vertical piping shall be maintained in straight alignment between floors with midstory guides.

Pipe and fittings shall be so positioned that identifying markings shall be readily visible for inspection. [UPC 310.0]

<sup>1</sup> Although referenced in this standard, some of the fittings shown in the standard are not acceptable under the Uniform Plumbing Code.

<sup>2</sup> It is common practice to dual mark Schedule 40 DWV and potable water piping in which compliance with each applicable standard is met.

**2.3 Protection of Piping****2.3.1 Storage**

Pipe and fittings should not be stored in direct sunlight; however, exposure to sunlight during normal construction periods is not considered harmful. Pipe shall be stored in such a manner as to prevent sagging or bending. [UPC 313.0]

**2.3.2 Expansion and Contraction**

Thermal expansion and contraction of plastic drain waste and vent systems shall be taken into consideration. Thermal expansion and contraction may be controlled by several methods: offset, expansion joints, or restraints.

Regardless of method utilized, certain conditions shall be met:

- (a) Support, but do not rigidly restrain piping at changes of direction.
- (b) Do not anchor pipe rigidly in walls.
- (c) Holes through framing members must be adequately sized to allow for free movement.

DWV installation with frequent changes in direction will compensate for thermal expansion and contraction.

Expansion joints may be utilized in vertical straight runs in excess of 30 feet (9144 mm) provided they are installed per manufacturer's installation instructions.

Except piping buried below ground, horizontal and vertical piping should be installed with restraint fittings or a minimum of 24 inches (610 mm) 45° offset every 30 feet (9144 mm). Thermal expansion for installation subject to temperature changes may be determined from Table 3-1. The linear expansion shown is independent of the diameter of the pipe.

**2.3.3 Exposed Piping**

Piping shall not be exposed to direct sunlight. Exception: Vent piping through roof. Plumbing vents through roof, exposed to sunlight, shall be protected by water base synthetic latex paints.

Adequate support shall be provided where PVC piping is exposed to wind, snow and ice loading.

**2.3.4 Protection from Damage**

Piping passing through wood studs or plates shall be protected from puncture by minimum 1/16 inch (1.6 mm) thick steel plate.

Piping shall be protected from concrete form oil.

**2.3.5 Anti-Freeze Protection**

PVC pipe and traps can be protected from freezing by the use of one of the following solutions of mixtures:

- (a) 4 quarts (3.8 liters) of water mixed with 5 quarts (4.8 liters) of glycerol
- (b) 2-1/2 lbs. (1.1 kg) of magnesium chloride dissolved in one (1) gallon (3.8 liters) of water
- (c) 3 lbs. (1.4 kg) of table salt dissolved in one (1) gallon (3.8 liters) of water.

The salt solutions are effective to approximately 10°F (-12°C). If lower temperatures are anticipated, the pipe should be drained or the glycerol solution should be used.

**2.4 Piping Installed in Fire Resistive Construction**

Where piping is installed and penetrates required fire resistive construction, the fire resistive integrity of the construction shall be as required by the Administrative Authority, or when not established by the Building Code, by qualified testing methods approved by the Administrative Authority. Approval shall be obtained prior to installing any such piping.

**2.5.0 Hangers and Supports****2.5.1 Abrasion**

Hangers and straps shall not compress, distort, cut, or abrade the piping and shall allow free movement of pipe. Pipe, exposed to damage by sharp surfaces, shall be protected. [UPC 314.0]

**2.5.2 Support**

Support all horizontal piping at intervals of not more than four (4) feet (1219 mm), at end of branches, and at change of direction or elevation. Supports shall allow free movement, but shall restrict upward movement of lateral runs so as not to create reverse grade. Vertical piping shall be supported at each story or floor level. Alignment of vertical piping shall be maintained between floors with the use of a mid-story guide. Support trap arms in excess of three (3) feet (915 mm) in length as close as possible to the trap. Closet flanges shall be securely fastened with corrosive resistant fasteners to the floor with top surface one-quarter (1/4) inch (6.4 mm) above finish floor.

**TABLE 1  
PVC-DWV TYPE I  
THERMAL EXPANSION TABLE**

Chart Shows Length Change in Inches  
vs. Degrees Temperature Change

Coefficient of Linear Expansion:  $e = 2.9 \times 10^{-5}$  in/in °F

Length (feet)	40°F	50°F	60°F	70°F	80°F	90°F	100°F
20	0.278	0.348	0.418	0.487	0.557	0.626	0.696
40	0.557	0.696	0.835	0.974	1.114	1.235	1.392
60	0.835	1.044	1.253	1.462	1.670	1.879	2.088
80	1.134	1.392	1.670	1.949	2.227	2.506	2.784
100	1.392	1.740	2.088	2.436	2.784	3.132	3.480

**TABLE 1 (Metric)  
PVC-DWV TYPE I  
THERMAL EXPANSION TABLE**

Chart Shows Length Change in Millimeters  
vs. Degrees Temperature Change

Coefficient of Linear Expansion:  $\frac{0.2 \text{ mm}}{\text{mm } ^\circ\text{C}}$

Length (mm)	4°C	10°C	16°C	21°C	27°C	32°C	38°C
6096	7.1	8.8	10.6	12.4	14.2	15.9	17.7
12192	14.2	17.7	21.2	24.7	28.3	31.4	35.4
18288	21.2	26.5	31.8	37.1	42.4	47.7	53.0
24384	28.8	35.4	42.4	49.5	56.6	63.7	70.7
30480	35.4	44.2	53.0	61.9	70.7	79.6	88.4

Example:

Highest temperature expected 100°F (38°C)  
 Lowest temperature expected 50° F (10°C)  
 -50°F (10°C)

Length of run – 60 feet (18288 mm) from chart, read 1.044 inches (26.5 mm) linear expansion that must be provided for.

**2.6 Traps**

**2.6.1 Connection to Traps**

Traps shall be connected by means of listed trap adapters. [UPC 1003.0]

**2.7 Joints**

**2.7.1 Caulked Joints**

Make connections or transitions to bell-and-spigot cast iron soil pipe fittings, and to bell-and-spigot pipe and fittings of other materials with listed 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 one (1) inch (25.4 mm). Allow a period of four (4) minutes for cooling,

following which, caulk the lead at the inside and outside edges of the joint. Lead shall not be overheated. [UPC 705.1.1]

**2.7.2 Solvent Cement Joints**

(Additional information is available in ASTM D2855.)

**2.7.3 Selection.** Follow manufacturer’s recommendations for type of solvent cement for such conditions as temperature over 100°F (38°C), or humidity over 60%.

**2.7.4 Handling (to maintain effectiveness).**

Solvent cement and primer containers no larger than 1 quart (1 liter) should be used in the field (to avoid thickening due to evaporation). Keep containers closed and in the shade when not in use. Keep applicator

submerged in solvent cement between applications. When solvent cement becomes thicker, THROW IT AWAY. Solvent cement shall NOT be thinned.

**2.7.5 Size of Applicator.** Applicator should be about one-half the pipe diameter. Do not use small applicator on large pipes. Ordinary pure bristle paint brushes or applicators furnished with product are satisfactory. [UPC 316.1.6]

**2.7.6 Primers.** A listed primer in compliance with ASTM F 656 shall be used on all PVC DWV joints.

**2.7.7 Application.** Solvent cement and primer shall be applied deliberately, but without delay (two men may be needed to make large joints). Use special care when temperature is over 100°F (38°C) or humidity is over 60%.

## **2.7.8 SAFETY REQUIREMENTS AND PRECAUTIONS**

**2.7.8.1 General.** *Solvents contained in PVC plastic pipe cements are classified as airborne contaminants and flammable and combustible liquids. Precautions listed in this appendix should be followed to avoid injury to personnel and the hazard of fire.*

**2.7.8.2 Safety Precautions.** *Prolonged breathing of solvent vapors should be avoided. When pipe and fittings are being joined in partially enclosed areas, a ventilating device should be used in such a manner to minimize the entry of vapors into the breathing areas.*

**2.7.8.3** *Solvent cements should be kept away from all sources of ignition, heat, sparks, and open flame.*

**2.7.8.4** *Containers for solvent cements should be kept tightly closed except when the cement is being used.*

**2.7.8.5** *All rags and other materials used for mopping up spills should be kept in a safety waste receptacle which should be emptied daily.*

**2.7.8.6** *Most of the solvents used in PVC pipe cements can be considered eye irritants and contact with the eye should be avoided for it may cause eye injury. Proper eye protection and the use of chemical goggles or face shields is advisable where the possibility of splashing exists in handling solvent cements. In case of eye contact, flush with plenty of water for 15 minutes and call a physician immediately.*

**2.7.8.7** *Repeated contact with the skin should be avoided. Proper gloves impervious to and unaffected by the solvents should be worn*

*when frequent contact with the skin is likely. Application of the solvents or solvent cements with rags and bare hand not recommended. Brushes and other suitable applicators can be used effectively for applying the solvent cement, thus avoiding skin contact. In the event of excessive contact, remove contaminated clothing and wash skin with soap and water.*

Step 1 Cut pipe square with hand saw and miter box, mechanical cut-off saw or tube cutter designed for plastic.

Step 2 Ream inside and chamfer outside of pipe (to eliminate all burrs).

Step 3 Clean all dirt, moisture and grease from pipe and socket. Use a clean, dry rag.

Step 4 Check dry fit of pipe in fitting. Pipe should enter fitting socket from 1/3 to 3/4 depth of socket.

Step 5 Soften inside socket surface by applying an aggressive primer.

Step 6 Soften mating outside surface of pipe to depth of socket by applying a liberal coat of the (aggressive) primer. Be sure the entire surface is softened.

Step 7 Again coat inside socket surface with the (aggressive) primer. Then, without delay, apply solvent cement liberally to outside of pipe. Use more than enough to fill any gaps.

Step 8 Apply a light coat of PVC solvent cement to inside of socket using straight outward strokes (to keep excess solvent out of socket). This is also to prevent solvent cement damage to pipe. For loose fits, apply a second coat of solvent cement. Time is important at this stage. See Section 2.7.6.

Step 9 While both the inside socket surface and the outside surface of the pipe are SOFT and WET with solvent cement, forcefully bottom the pipe in the socket, giving the pipe a one-quarter turn, if possible. The pipe must go to the bottom of the socket.

Step 10 Hold the joint together until tight. (Partial set).

Step 11 Wipe excess cement from the pipe. A properly made joint will normally show a bead around its entire perimeter. Any gaps may

indicate insufficient cement or the use of light bodied cement on larger diameters where heavy bodied cement should have been used.

Step 12 The system shall not be tested until the joints have cured (set) at least as long as recommended by the manufacturer.

### 2.7.9 Threaded Joints

Listed adapter fittings shall be used for the transition to threaded connections. No threaded PVC female fitting(s) or joint(s) shall be located in a non-accessible location. The joint between the PVC pipe and adapter fittings shall be of the solvent cement type.

Only listed thread tape or thread lubricant, specifically intended for use with plastics, shall be used. Conventional pipe thread compounds, putty, linseed oil base products, and unknown mixtures shall not be used. Pipe and fittings which have come in contact with the above non-approved mixtures shall be removed and replaced with new materials.

Where a threaded joint is made, obtain tightness by maximum hand tightening plus additional tightening with a strapwrench not to exceed one full turn.

### 2.7.10 Special Joints

#### 2.7.10.1 Connection to Non-Plastic Pipe

When connecting plastic pipe to other types of piping, use listed fittings and adapters designed for the specific use intended. [UPC 316.2]

### 2.7.11 Prohibited Joints and Connections

- (a) Drainage System – Any fitting or connection which has an enlargement, chamber or recess with a ledge, shoulder, or reduction of pipe area, that offers an obstruction to flow through the drain is prohibited.
- (b) No fitting or connection that offers abnormal obstruction to flow shall be used. The enlargement of a three (3) inch (76 mm) closet bend or stub to four (4) inches (102 mm) shall not be considered an obstruction. [UPC 316.4]

**ADOPTED: 1968**

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