Designation: F2158 – 08 (Reapproved 2016)

An American National Standard

Standard Specification for Residential Central-Vacuum Tube and Fittings[1]

This standard is issued under the fixed designation F2158; 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 the establishment of requirements and test methods for materials, dimensions and tolerances, flattening resistance and impact resistance of plastic tubing for use in central-vacuum systems for residential buildings.

1.2 All notes and footnotes shall be considered as nonmandatory requirements of the specification.

1.3 This specification does not apply to: inlet valve mounting plates of fittings directly connected to these plates, reducer fittings, mufflers exhaust vents, or flex tubing attached at the power unit location.

1.4 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.

1.5 *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 requirements 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

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

D2749 Symbols for Dimensions of Plastic Pipe Fittings

D5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics (Withdrawn 2007)[3]

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

3. Terminology

3.1 Definitions are in accordance with Terminology F412, abbreviations are in accordance with Terminology D1600, and dimension symbols are in accordance with Specification D2749.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *central-vacuum tubing, n*—piping used for central-vacuum systems, that is O.D. controlled.

3.2.2 *unaided eye, n*—observable without enhancement beyond correction for normal vision.

4. Significance and Use

4.1 The requirements of this specification are intended to provide tube and fittings for central-vacuum cleaning systems, used to convey debris from the vacuum inlets to the central-vacuum power units.

5. Materials

5.1 *Basic Materials*—The tube and fittings shall be made of virgin plastic having a cell classification of equivalent to or greater than that for poly (vinyl chloride) (PVC) 12454, 13354, and 12223, as defined in Specification D1784. Compounds that have different cell classifications, because one or more properties are superior to those of the specified compounds, are also acceptable.

[1] This specification is under the jurisdiction of ASTM Committee F11 on Vacuum Cleaners and is the direct responsibility of Subcommittee F11.50 on Special Vacuum Cleaner Types.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

5.2 *Recycled Material*—The use of recycled materials as defined in Guide D5033 is acceptable as long as the material meets the cell classification requirements in 5.1.

5.3 *Solvent Cement*—Where solvent cement is used to join PVC tube and fittings, it shall meet the requirements of Specification D2564.

6. Requirements

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

6.1.1 *Tube and Fitting Flattening*—There shall be no evidence of splitting, cracking, or breaking when the tube and fittings are tested in accordance with 7.4.

6.1.2 *Tube and Fitting Impact Strength*—The impact strength of the tube and fittings at the time of manufacture shall not be less than 20 ft·lbf (27 J), when tested in accordance with 7.5.

6.2 *Dimensions and Tolerances:*

6.2.1 *Tube Dimensions*—The tube dimensions shall meet the requirements given in Table 1, when measured in accordance with Test Method D2122.

6.2.1.1 *Tube Length*—The tolerance on the tube length shall be ±½ in. (±12.5 mm).

6.2.2 *Fitting and Tube Hub Dimensions*—The dimensions of fittings and tube hubs shall meet the requirements of Table 2 and Fig. 1, when measured in accordance with Test Method D2122.

6.2.3 *Belled Tube*—For belled tube fabricated from tube sections, the thickness of the belled section shall be considered satisfactory if the bell was formed from tube meeting the requirements of Table 1.

7. Test Methods

7.1 *Sampling*—The selection of tube samples shall be as agreed upon between the purchaser and seller. In case of no prior agreement, samples selected by a testing laboratory shall be deemed adequate.

7.2 *Tube Test Specimens*—For testing in accordance with 7.4 and 7.5, cut each test specimen from the selected tube to a minimum of 6 ± ⅛ in. (152 ± 3.175 mm) in length. Deburr the edges of each specimen on the inner and outer diameter.

7.3 *Conditioning*—For time-of-manufacture testing, conditioning shall be permitted at the ambient temperature and humidity of the manufacturer's facility. For referee purposes, conditioning shall be in accordance with Procedure A of Practice D618.

TABLE 1 Outside Diameters and Tolerances for Vacuum Tubing, in. (mm)

Nominal Tube Size	Wall Thickness			
	max	min	min	max
2	2.005 (50.93)	1.995 (50.67)	0.060 (1.52)	0.070 (1.78)

TABLE 2 Fitting and Tube Hub Dimensions, in. (mm)

Nominal Size	Socket Entrance-Diameter			Socket Bottom-Diameter			Socket Depth, min	Wall Thickness, min[A]
	min[A]	max[A]	OOR	min[A]	max[A]	OOR		
2	2.005 (50.93)	2.015 (51.18)	+0.015 (0.38)	1.990 (50.54)	2.000 (50.8)	+0.015 (0.38)	0.730 (18.54)	0.085 (2.16)

[A]The wall thickness is a minimum value except that a ±10 % variation resulting from core shift is allowed. In such case, the average of the two opposite wall thicknesses shall equal or exceed the value shown in the table.

7.4 *Tube and Fitting Flattening*—Flatten three test specimens between parallel plates in a press until the distance between the plates is 40 % of the outside diameter of the tube or fitting. The rate of loading shall be uniform and such that the flattening is completed within 2 to 5 min. On the removal of the load, the specimen shall pass if no splitting, cracking, or breaking is observed under normal light with the unaided eye.

7.5 *Impact Resistance*—Determine the impact resistance of the tube or fitting in accordance with Appendix X3.5, "Procedure–Specification Requirement," of D2444. Use either a 6-lb (2.7-kg) or a 20-lb (9.1-kg) B tup and the flat plate (holder B). Test six specimens at an impact of 20 ft·lbf (27 J). If all six specimens pass, accept the lot. If one specimen fails, test another six specimens. If eleven of twelve specimens pass, accept the lot. If two or more specimens fail, reject the lot.

8. Retest and Rejection

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

9. Product Marking

9.1 *Tube Marking*—The markings shall be applied to the tube in such a manner that they remain legible after installation.

9.2 *Content of Marking*—The tube shall be marked at least every 5 ft (1.5 m) in letters not less than 3⁄16 in. (5 mm) high, in a contrasting color, with the following information.

9.2.1 The manufacturer's name (or trademark).

9.2.2 The designation "ASTM F2158."

9.2.3 Nominal Pipe Size (for example, 2 in. (50 mm)).

9.2.4 The material identification for example "PVC Vacuum Tubing."

9.3 *Fitting Markings:*

9.3.1 Manufacturer's name (or trademark).

9.3.2 The designation ASTM F2158.

9.3.3 Nominal tube size.

9.3.4 The material identification symbol, for example, PVC.

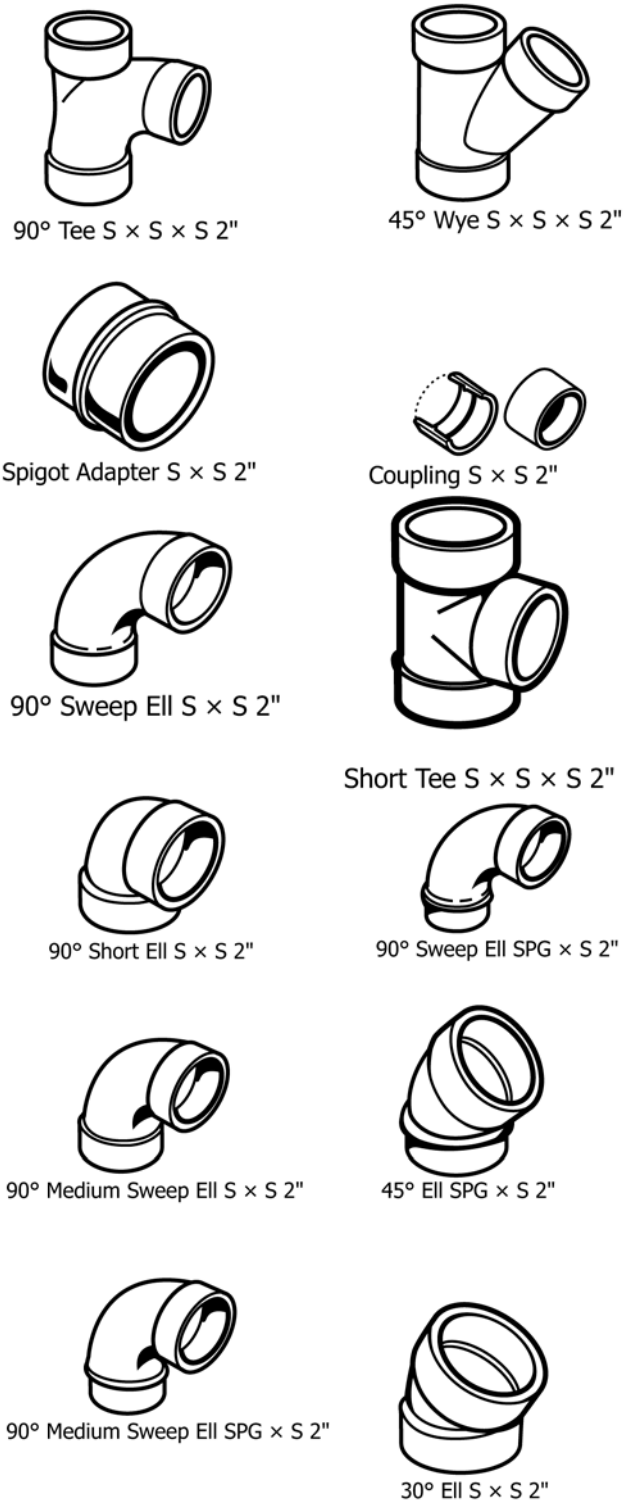

FIG. 1 Typical Fitting Configurations

10. Quality Assurance

10.1 When the product is marked with this designation, ASTM F2158, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with and has been found to meet the requirements of this specification.

11. Keywords

11.1 central vacuum; fittings; PVC; tube

APPENDIXES

(Nonmandatory Information)

X1. STORAGE

X1.1 *Outside Storage*—Plastic tube should be stored on a flat surface or supported in a manner that will prevent sagging or bending. Do not store tube in direct sunlight for long periods. To prevent damage, fittings should not be stored where the temperature exceeds 100°F (38°C).

X1.2 Inventories of plastic tube should be used on a first-in, first-out basis.

X2. JOINTS AND CONNECTIONS

X2.1 PVC tubing and fittings shall be joined by the solvent-cement method.

X2.2 When connecting to metal tubing systems, metal tubing and fitting shall be joined in accordance with Appendix X4.

X3. SOLVENT CEMENT JOINTS

X3.1 *Tube Cutting*—Cut the tube square with the axis, using a fine-tooth handsaw and a miter box. A rotary cutter may be used if the cutting blades are specifically designed for cutting plastic tube in such a way as not to raise a burr or ridge (flare) at the cut end (see Fig. X3.1). Remove all burrs with a deburring tool, knife, file, or abrasive paper.

X3.2 *Dry Fit Test*—The solvent cement joint is designed so that there will generally be interference of the tube wall with the fitting socket before the tube is fully inserted. Insert the tube into the fitting and check that the interference occurs about ⅓ to ⅔ of the socket depth (see Fig. X3.2).

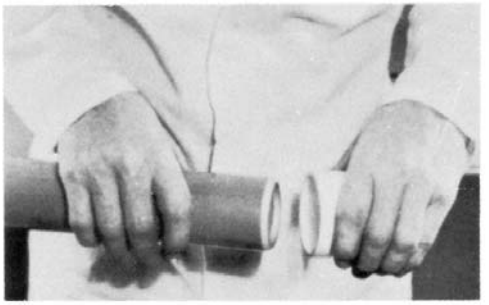

FIG. X3.2 Tube Entering Dry Fitting

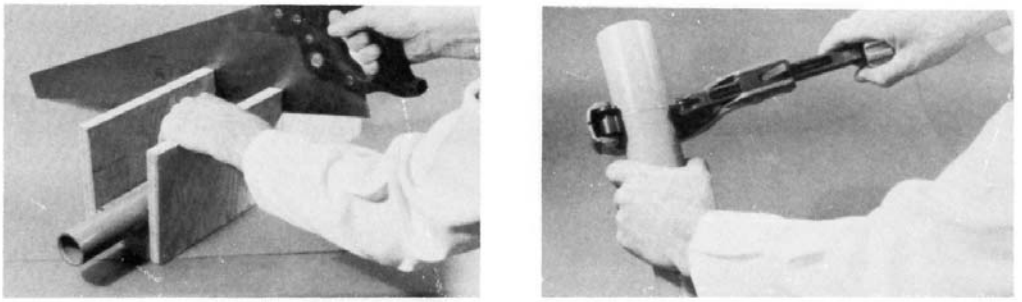

FIG. X3.1 Apparatus for Cutting Tube

X3.3 *Cleaning*—Surfaces to be joined must be cleaned and be free of dirt, moisture, oil, and other foreign material. If this cannot be accomplished by wiping with a clean, dry cloth, a chemical or mechanical cleaner must be used. If a chemical cleaner is used, apply with an applicator. (**Warning—**Skin contact with chemical cleaners should be avoided.)

X3.4 Application Procedure

X3.4.1 *Handling Cement*—Keep the cement can closed and in a shady place when not actually in use. Discard the cement when an appreciable change in viscosity takes place or at the first sign of gelation. The cement should not be thinned. Keep the applicator immersed in cement between applications.

X3.4.2 *Application of Cement*—PVC solvent cement is fast drying, and, therefore, the cement shall be applied as quickly as possible, consistent with good workmanship (see Fig. X3.3).

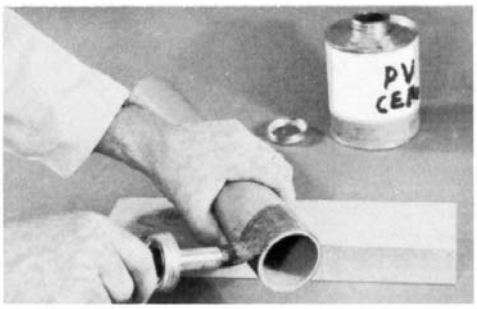

FIG. X3.3 Uniform Application of Cement to Outside of Tube

The surface temperature of the mating surfaces should not exceed 110°F (43°C) at the time of assembly.

X3.4.3 Apply cement lightly but uniformly to the outside of the tubing, taking care to keep the use of cement to a minimum. (**Warning—**Application of cement to fitting socket is not recommended and can cause drippings or an excess amount of cement to be pushed to the inside diameter of the connection that can possibly snag debris and eventually create a clog.)

X3.4.4 *Low-Temperature Applications*—At temperatures below freezing, 32°F (0°C), solvents penetrate and soften the PVC surfaces more slowly than in warmer weather. For this reason, it is recommended that testing be done on a piece of scrap tube to determine if satisfactory penetration of the surfaces can be achieved.

X3.4.5 *Assembly of Joint*—Immediately after applying a coat of cement to the tube, forcibly insert the tube into the socket. To distribute the cement evenly, turn the tube or fitting a ¼ turn during the process (see Fig. X3.4).

X3.4.6 Assembly should be completed within 20 s after the application of cement. (**Warning—**Until the cement is set in the joint, the tube may back out of the fitting socket, if not held in place for approximately 1 min after assembly. Care should be taken during assembly not to disturb or apply any force to the joints previously made, as early rough handling can destroy fresh joints.)

X3.4.7 See Practice F402, "Practice for Safe Handling of Solvent Cements, Primers and Cleaners Used for Joining Thermoplastic Pipe and Fittings."

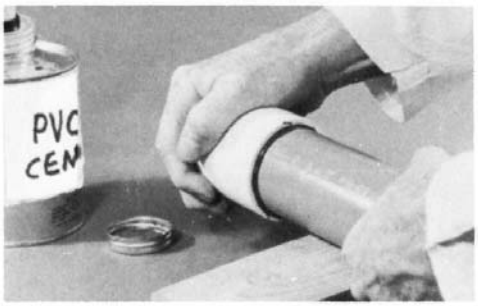

FIG. X3.4 Assembly of Joint

X4. METHODS OF JOINING METAL TUBING AND FITTINGS

X4.1 *Tube Cutting*—Cut the tube square with the axis, sing a metal cutting blade in cutting blade in chop saw or band saw. A rotary cutter may be used if the cutting blades are specifically designed for cutting metal tube in such a way as not to raise a burr or ridge (flare) at the cut end. Remove all burrs with a deburring tool, file, or abrasive paper.

X4.2 *Cleaning*—Surfaces to be joined must be cleaned and free of dirt, moisture, oil, and other foreign material. If this cannot be accomplished by wiping with a clean, dry cloth, a chemical or mechanical cleaner must be used. If a chemical cleaner is used, apply with applicator. (**Warning—**Skin contact with chemical cleaners should be avoided.)

X4.3 *Assembly of Joint*—There are three popular and recommended methods of joining metal tubing and fittings for use in low vacuum and pressure systems under 16 psig (Adhesive, Compression Couplings and Shrink Sleeves). All of these methods provide secure connections eliminating the need for welding or brazing.

X4.3.1 *Adhesive*—The best proven adhesive to bond metal tubing and fittings together is industrial contact cement. For best results, apply coatings of equal thickness on each clean surface to be joined. Do not join immediately. When both surfaces are tacky to the touch, insert the tubing full depth into the fitting socket. Make sure excess adhesive has not been pushed to the inside diameter of the tubing (if any has, be sure to remove it to prevent any future obstruction areas).

X4.3.2 *Compression Coupling*—A mechanically fastened coupling that connects straight end tubing of fittings within the ID of coupling. These couplings offer an easy "tear down" or "repair" function. (See Fig. X4.1.)

X4.3.3 *Shrink Sleeve*—A heat shrinkable polyolefin band literally shrinks and encircles the connection, thus giving it mechanical strength and a positive seal. This joining method can be used in conjunction with slip couplings, expanded tubing, or fittings. Depending on weather conditions, shrink sleeves typically can be installed in as little as 1 to 2 min each. (See Fig. X4.2.)

X4.3.3.1 *Equipment Needed to Apply Shrink Sleeve:*

(1) A propane or butane torch having a broad 12-in. or 15-in. billowy orange flame.

(2) Or a commercial heat gun with 500°F (14 amp) capability.

X4.3.3.2 *Applying Shrink Sleeve:*

(1) Slip shrink sleeve over the clean tube before joining fittings together, join fittings and center shrink sleeve over joint area.

(2) Apply heat, starting in center over joint and work towards ends—applying heat as uniformly as possible around the circumference of the sleeve.

(3) Operation is complete when the sleeve is in 360 degree contact with the tube and small amount of molten adhesive is visible at both ends of sleeve.

(4) The joined connection may be moved when the sleeve and joint area are cool enough to hold with bare hands.

(5) For repair—simply cut the sleeve with a knife or razor blade and remove.

X4.4 *Tubing Support*—All horizontal runs of the system must be securely supported and fastened with tube hangers. Hangers should be spaced on 10-ft centers. All vertical tubing must be firmly held in place.

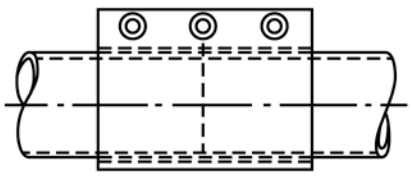

FIG. X4.1 Compression Coupling

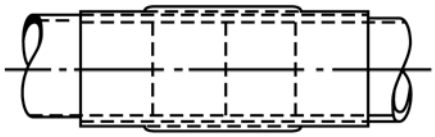

FIG. X4.2 Shrink Sleeve

FIG. X4.3 Improved Compression Coupling

X5. SYSTEM INSTALLATION

X5.1 To determine the location of hose inlet-valves, identify locations that will provide the maximum area of cleaning coverage, usually on inside walls in hallways, near doorways, archways, and at the bottom of stairways. (**Warning—** Installation of a tubing system will vary depending on the architecture of the building; however, some features are common and are addressed. Other features are referenced in the Manufacturer's installation instructions.)

X5.1.1 After locating the hose inlet-valve, (unless the hose is shorter), use a 30-ft (9.1 m) length of cord or string to ensure that the maximum area of cleaning coverage is accessible. Drawings or plans may be used as well as the actual building. Floor plans are normally ¼ in. scale (1:50 cm). A 7 in. (180 mm) piece of string or beaded chain will help determine the optimum location. Keep in mind that furniture, doors, and other obstacles will prevent hoses from reaching the maximum 30 ft (9.1 m), so valve placement and quantity is important to ensure that all areas to be cleaned can be reached by the hose.

X5.1.2 Check the tubing path to avoid possible obstructions, such as heating ducts. Installation is best accomplished by running a trunk line leading from the farthest inlet valve to the power unit with branch lines running to the individual valves. Lines may be installed in partitions, attics, and crawl spaces, under or between floor joists, or on faces of walls or columns. It is always best to keep trunk lines and branch lines as straight as possible without unnecessary bends and turns.

X5.2 *Recommended Tools*:

(a) ½ in. (1.3 cm) right angle drill or ½ in. (1.3 cm) drill
(b) 2¼ in. (5.7 cm) hole saw or cutter
(c) ¼ in. (6.4 mm) masonry drill bit
(d) Common hacksaw or small handsaw with 18 teeth/in. blade or 2 in. PVC tube cutter
(e) Miter box
(f) Steel measuring tape
(g) Screwdriver (Phillips)
(h) Screw driver (slot)
(i) Wire connectors for #20 AWG (min) wire
(j) Side cutters
(k) Hammer
(l) Wire coat hanger
(m) Pocket or utility knife
(n) Flashlight
(o) Drywall saw or jig saw
(p) Deburring and chamfering tool for PVC tubing
(q) Electrical tape
(r) Propane or butane torch
(s) Safety gloves
(t) Wire snippers

X5.3 *Installation of Hose Inlet Valves:*

X5.3.1 The hole in the wall for the hose inlet-valve should be located between studs, clear of obstructions such as plumbing, wiring, and heat ducts.

NOTE X5.1—The minimum stud depth for sufficient clearance of an adapter elbow is 2¾ in. (70 mm).

X5.3.2 Determine the exact location of the hose inlet-valve and select a point on the floor directly below vertical center of the desired location. Drill a small hole (against the wall) through the flooring and subflooring. The straight section of a coat hanger cut at an angle makes a good pilot hole drill bit. From beneath the floor, this pilot hole will serve as a guide point from which you can measure over approximately 2½ in. (63 mm) to locate and drill a 2¼ in. (57 mm) diameter hole in the center of the sole plate. If it is a slab construction, additional planning will be required to come down from the attic area.

X5.3.3 Before cutting the hole in the wall for the mounting bracket, drill the 2¼ in. (57 mm) diameter hole up through the sole plate and, using a flashlight, inspect the interior of the wall to be sure there are no obstructions.

X5.3.4 Having determined that there are no obstructions in the wall, cut a hole for the mounting bracket using a single blade drywall saw or jig saw.

NOTE X5.2—Refer to the manufacturer's installation manual for confirmation of hole size required for mounting brackets and hose inlet-valves.

X5.3.5 The end of the tubing is passed up through the hole in the sole plates so as to be visible to the hose inlet-valve opening.

NOTE X5.3—At this point, follow the manufacturer's instructions, as different valves will have different methods of attachment and wiring instructions.

X5.4 Power Unit Connections

X5.4.1 Power units are to be wall mounted approximately 28 in. (71.12 cm) from the floor with a minimum clearance of 6 in. (15.25 cm) from the ceiling, sidewall, or any obstruction, so as to facilitate motor cooling.

NOTE X5.4—Dimensions may vary from manufacturer to manufacturer.

X5.4.2 Piping connections to the inlet side of the power unit are fastened with hose clamps and flexible couplings or solvent cemented to a mechanically attached adapter.

X5.4.3 Attach the low-voltage #20 AWG (min) wires to the low voltage terminals of the power unit, using the specific terminals supplied by the manufacturer.

X5.4.4 Connections to the exhaust side of a power unit shall be the same as described in X5.4.2.

X5.4.5 Low-voltage wire must follow the tubing system. At the junction of a branch line and the trunk line, the wires must be spliced together. Each inlet valve must be able to activate the power unit independently of the other valves. The wire shall be attached to the tubing with supplied clips, cable ties, or electrical tape, at least every 4 ft (122.4 cm).

X5.5 *Fire Penetrations*—Where required, fire penetrations shall be installed in accordance with the local building-code requirements.

X5.6 Testing

X5.6.1 Take the vacuum hose and insert it in the farthest valve. The power unit should start automatically. If the assembly has a low-voltage switch, ensure the switch is in the on position.

X5.6.2 Remove the hose and the power unit should shut off.

X5.6.3 While the hose remains in the inlet valve, check the other inlets for air tightness. The sound of a hiss indicates an air leakage. By either loosening or tightening the inlet-valve mounting screws, the leakage may be corrected.

X5.6.4 Remove the hose from the inlet valve and repeat X5.6.1 – X5.6.3 for each remaining outlet.