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An American National Standard

# Standard Guide for Approved Methods of Installing a CVS (Central Vacuum System)[1]

This standard is issued under the fixed designation F2647; 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 guide demonstrates proper methods for installing a central-vacuum system.

1.2 Appendix X1 contains additional sources of information that may be helpful to the user of this guide.

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

1.4 *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]

E814 Test Method for Fire Tests of Penetration Firestop Systems

E2174 Practice for On-Site Inspection of Installed Firestops

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

F2158 Specification for Residential Central-Vacuum Tube and Fittings

## 3. Terminology

3.1 *Definitions:*

3.2 For definitions of terms used in this guide, see Terminology F412.

## 4. Significance and Use

4.1 The suggestions of this guide are intended to provide proper installation materials and practices to be used during the installation of a central-vacuum system.

## 5. Materials

5.1 *Plastic Materials*—For information on plastic materials used for installing a CVS system, see Specification F2158.

[1] This guide is under the jurisdiction of ASTM Committee F11 on Vacuum Cleaners and is the direct responsibility of Subcommittee F11.30 on Durability-Reliability.

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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.

# 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, tubing and fittings should not be stored where the temperature exceeds 130°F (54°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 Metal tubing and fittings shall be joined according to 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 (Fig. X3.2).

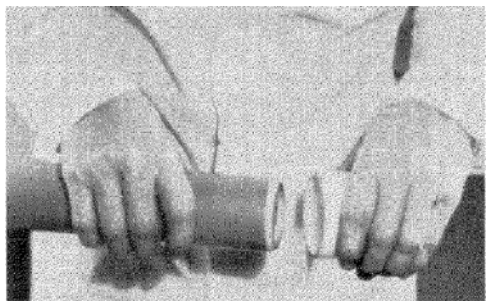

**FIG. X3.2 Tube Entering Dry Fitting**

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. (See Practice F402 for proper handling procedures.)

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). 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

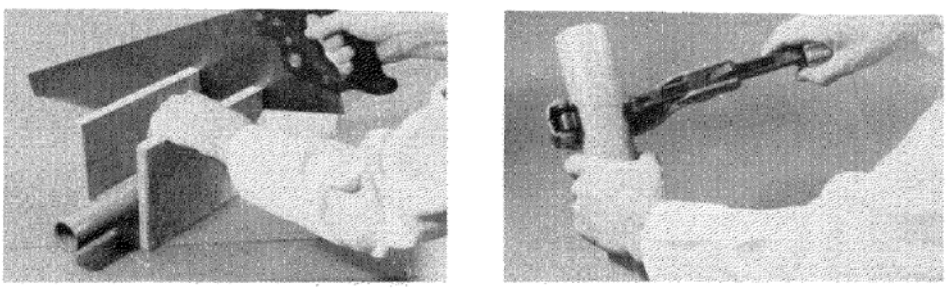

**FIG. X3.1 Apparatus for Cutting Tube**

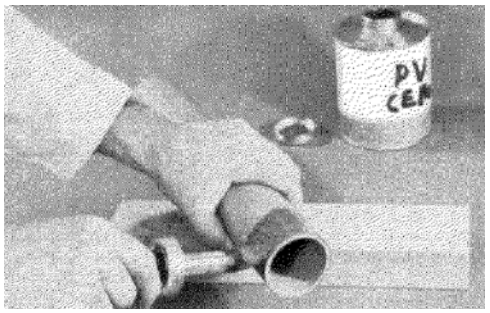

FIG. X3.3 Uniform Application of Cement to Outside of Tube

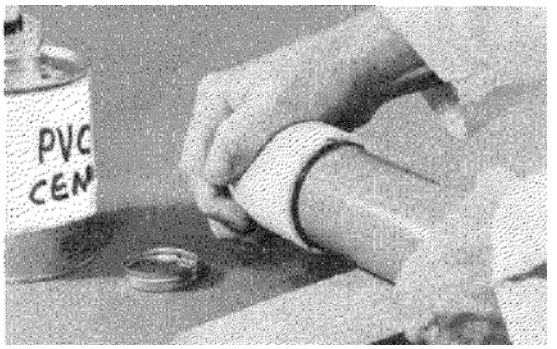

FIG. X3.4 Assembly of Joint

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.)

## X4. METHODS OF JOINING METAL TUBING AND FITTINGS

X4.1 *Tube Cutting*—Cut the tube square with the axis, using a metal cutting blade in a 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 an 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 touch, insert the tubing the 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 Couplings*—A mechanically fastened coupling that connects straight end tubing or fittings within the ID of the coupling. These couplings offer an easy "tear down" or "repair" function (see Fig. X4.1 and Fig. X4.2).

X4.3.3 *Shrink Sleeve*—A heat shrinkable polyolefin band literally shrinks and encircles the connection 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 1-2 min each (see Fig. X4.3).

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

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

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

X4.3.3.2 *Applying Shrink Sleeve*:

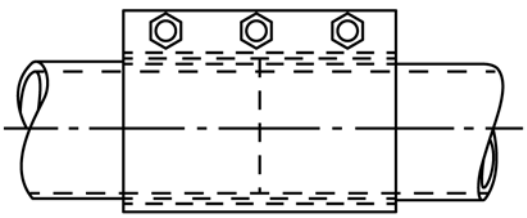

FIG. X4.1 Compression Coupling

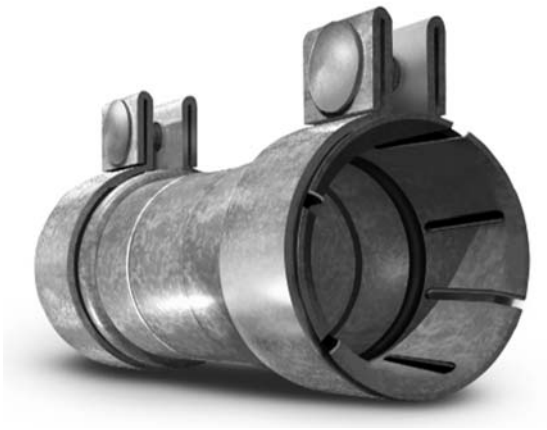

FIG. X4.2 Improved Compression Coupling

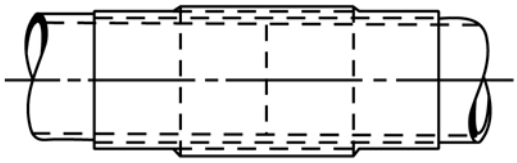

FIG. X4.3 Shrink Sleeve

*(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 the ends—applying heat as uniformly as possible around the circumference of the sleeve.

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

## 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.) Support for the tubing to be not less than every 4 ft (122 cm).

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. (1.50 cm) scale. 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 hose inlet-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 hose inlet- valve to the power unit with branch lines running to the individual hose inlet-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:*

X5.2.1 ½-in. (1.3-cm) right angle drill or ½-in. (1.3-cm) drill,

X5.2.2 2 ¼ to 2 $^{9}/_{16}$-in. (5.7 to 6.5-cm) hole saw or cutter,

X5.2.3 ¼ in. (6.4 mm) masonry drill bit,

X5.2.4 Common hacksaw or small handsaw with 18 teeth/in. blade or 2 in. PVC tube cutter,

X5.2.5 Miter box,

X5.2.6 Steel measuring tape,

X5.2.7 Screw driver (Philips),

X5.2.8 Screw driver (slot),

X5.2.9 Wire connectors for #20 AWG (min) wire,

X5.2.10 Side cutters,

X5.2.11 Hammer,

X5.2.12 Wire coat hanger,

X5.2.13 Pocket or utility knife,

X5.2.14 Flashlight,

X5.2.15 Drywall saw or jig saw,

X5.2.16 Deburring and chamfering tool for PVC tubing,

X5.2.17 Electrical tape,

X5.2.18 Propane or butane torch,

X5.2.19 Safety gloves, and

X5.2.20 Wire snippers.

X5.3 *Installation of Hose Inlet Valves for an Existing Home (Finished Walls):*

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 2 ¾ 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 2 ½ in. (63 mm) to locate and drill a minimum 2 ¼-in. (57-mm) up to a maximum 2 9⁄16-in. (65-mm) diameter hole in the center of the 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 minimum 2 ¼-in. (57-mm) up to a maximum 2 9⁄16-in. (65-mm) diameter hole up through the 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 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 *Installation of Hose Inlet-Valves for a New Construction (Unfinished Walls):*

X5.4.1 Determine the exact location of the hose inlet-valve and mark location on nearest wall stud (usually same height as electrical outlets).

X5.4.2 Drill a minimum 2 ¼-in. (57-mm) up to a maximum 2 9⁄16-in. (65-mm) diameter hole in plate (bottom) centered 2 in. from front face and 2 in. from side of stud (see Fig. X5.1). If this is a slab construction you will come down from the attic and drill the minimum 2 ¼-in. (57-mm) up to a maximum 2 9⁄16-in. (65-mm) diameter hole down through the plate to get into the wall cavity.

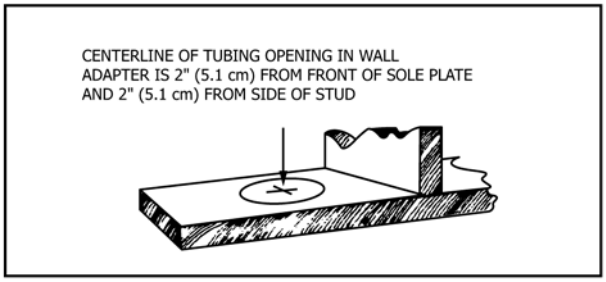


**FIG. X5.1 Centerline of Tubing Opening in Wall**

X5.4.3 Attach wall valve rough-in plate to stud at marked location.

X5.4.4 Install pipe to connect rough-in plate to future trunk line using the hole drilled in the plate.

X5.4.5 Attach low volt wire to rough-in plate by tying a knot at wire guide hole, then run wire along side of tubing back to future trunk line. (Check with local building code for special requirements on routing low voltage wire independently from tubing.)

X5.4.6 Install nail guards on plate to protect pipe from wall fasteners (see Fig. X5.2).

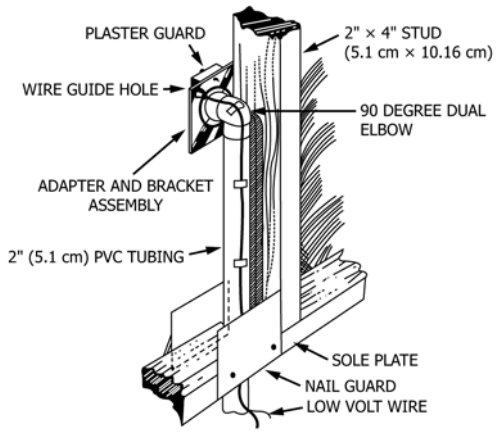


**FIG. X5.2 Stud-Mounting Bracket Assembly (New Construction)**

X5.4.7 Repeat steps X5.4.1 – X5.4.6 until all valve rough-in plates are connected to trunk line and accompanying low volt wires have been attached from one valve branch line to another where they meet the trunk line.

NOTE X5.4—If trunk line is not being installed at this time and branch lines are just being stubbed to the basement or attic, loop the extra wire around itself and place it inside the stubbed tube until final installation.

X5.4.8 Install sheet rock mud guards to cover rough-in plates during wall board assembly, finishing and painting.

X5.4.9 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).

X5.4.10 Once wall installation and finishing are complete, the central vacuum installer will return to the home to remove mud guards and install wall valves on to each rough-in plate. At this time X5.6 Power Unit Connection may also be completed.

X5.5 *Trunk Line Installation:*

X5.5.1 On existing homes this step will occur simultaneous with Power Unit Connection. On new construction homes it may occur at the time of roughing in the hose inlet-valve locations or during the final installation of hose inlet-valves and Power Unit Connection.

X5.5.2 Pipe should be routed from the furthest inlet branch toward the power unit using the least amount of bends. Care should be taken to utilize (2) 45 Ell or 30 Ell fittings instead of (2) Sweep 90 Ells whenever a pipe is being run from one parallel section to another.

X5.5.3 Tee or Wye connections should be made in such a manner as to always direct the flow toward the power unit (see Fig. X5.3 for proper flow).

X5.5.4 Care should be taken as to not join any branch lines into the trunk line from directly below the trunk line in such a manner as to allow a point of "drop-out" for debris flowing through the Tee or Wye.

X5.5.5 All branch lines must be connected to the trunk line at some point in the system.

X5.5.6 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 hose 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). As an alternate the low voltage wires may be "looped" to hose inlet-valve locations and splices made at the inlets.

X5.6 *Power Unit Connections:*

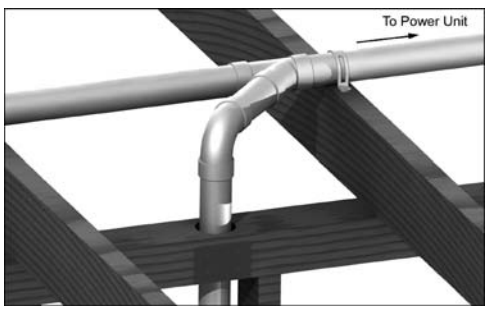


**FIG. X5.3 Pipe Connection**

X5.6.1 Power units are to be wall mounted according to the manufacturer's recommendations with a minimum clearance of 6 in. (15.25 cm) from the ceiling, sidewall, or any obstruction, so as to facilitate motor cooling.

X5.6.2 Piping connections to the inlet side of the power unit are to be fastened with hose clamps, flexible couplings, or mechanically attached adapters as per manufacturer's instructions.

X5.6.3 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.

X5.6.4 If required, connections to the exhaust side of a power unit should be the same as described in X5.6.2.

X5.7 *Fire Penetrations:*

X5.7.1 Where required, fire penetrations shall be installed in accordance with the local building-code requirements.

X5.7.2 Material used for fire stop must have been tested in accordance with standard Test Method E814.

X5.7.3 Inspection of fire penetrations should be conducted in accordance with standard Practice E2174.

X5.8 *Testing:*

X5.8.1 Take the vacuum hose and insert it in the farthest hose inlet-valve. The power unit should start automatically. If the hose assembly has a low-voltage switch, ensure the switch is in the on position.

X5.8.2 Remove the hose and the power unit should shut off.

X5.8.3 While the hose remains in the hose inlet-valve, check the other hose inlet-valves for air tightness. The sound of a hiss indicates an air leakage. By either loosening or tightening the hose inlet-valve mounting screws, the leakage may be corrected.

X5.8.4 Remove the hose from the hose inlet-valve and repeat X5.8.1 – X5.8.3 for each remaining hose inlet-valve.

## X6. UNDERGROUND TUBING AND FITTING INSTALLATION GUIDELINES

X6.1 The following guidelines give proper procedures for installing central vacuum tubing and fittings when it is required to run these items under the ground level or in a cement floor.

X6.1.1 Any central vacuum tubing or fittings, or both, placed underground or buried should be inserted into 3 in. (schedule 20 or 40) plumbing pipe and fittings. This will provide a protective shield around the central vacuum tubing to help prevent it from being crushed or punctured. The plumbing pipe will also provide a conduit for the low voltage wire to run along side the central vacuum tubing as well as prevent condensation and ground moisture from entering the central vacuum system tubing.

X6.1.2 Tubing should be buried a minimum depth of 18 in. or in accordance with local Plumbing Code when tubing is placed in an area not covered by a concrete slab.

X6.1.3 Be sure to securely bond and seal the 3 in. plumbing pipe and fittings together with the proper adhesive.

X6.1.4 Make all electrical connections above ground level for easy future access and to ensure moisture does not cause any electrical malfunctions.

X6.1.5 Where the central vacuum tube system enters and exits the ground level be sure to extend the 3 in. plumbing pipe above the ground or floor level by a minimum of 6 in.