PPFA

INTRODUCTION

This installation *Handbook* is prepared through the voluntary efforts of the members of the Plastic Pipe and Fittings Association. The Plastic Pipe and Fittings Association (PPFA) is the trade association of manufacturers of plastic pipe and fittings, producers of raw materials used in them, and suppliers of related products and services to the plastic pipe and fittings industry. PPFA provides a full range of association services for its members and the industry.

The *Handbook* is organized in sections based on the application or end use for each type of plastic piping, namely, Drain, Waste and Vent (DWV); Water Service Piping; Hot and Cold Water Distribution; and Sewer and Drains.

PURPOSE and SCOPE

The purpose of the *Handbook* is to provide plumbers and other interested persons with a single publication that describes plastic pipe products and many of the generally accepted installation practices for plastic pipe and fittings currently being utilized in the United States. It does not contain all of the information needed for comprehensive plumbing design and practices using plastic piping. While PPFA has attempted to collect and describe the most widely used, generally accepted installation techniques, there are undoubtedly some that were not included in this *Handbook*. Subsequent editions may add, drop, amend, or revise practices contained herein.

It should be clearly understood that neither PPFA nor its members recommend any single (or even all) installation practice described in this *Handbook* for any specific application or system. Both practical considerations and logic preclude such recommendations because of the wide variety of products and the considerable variation in circumstances surrounding the installation of these products. Accordingly, any plumber or other installer must refer first to the manufacturer's installation instructions and recommendations for the product or products being used. Any inconsistency or discrepancy between those recommendations and instructions and the material in this *Handbook* must be resolved in favor of the manufacturer's installation recommendations or instructions.

We urge you to read and study all information available to you on plastic piping.

Plastic piping is used extensively in the plumbing field for DWV, water service, hot and cold-water distribution systems, sewers, and drains. Learn to recognize and compare the various types of plastic pipe and tubing. The general term "plastic pipe" is no more definitive than saying "metal pipe." Just as you recognize cast iron, galvanized steel, copper, stainless steel, and brass, you will want to become familiar with the different kinds of plastic pipe and the advantages each offers.

Tools designed exclusively for use with plastic piping are available. We suggest that you secure brochures from your suppliers covering these tools. They contribute greatly to the ease and precision of the installation.

Neither PPFA nor its members make any warranties or representations whatsoever, either stated or implied, relative to the fitness of any product, materials, or procedures referred to in this *Handbook* for any particular purpose or use. Many of the products in this *Handbook* are interrelated, and we strongly suggest you read it in its entirety before you begin working with plastic pipe and fittings.

Plumbing codes & product standards

It is well known that plumbing codes were developed to protect the health and welfare of the communities by preventing contamination of the water supply and providing for the proper disposal of wastewater. These plumbing codes set forth many requirements for acceptable products and usually reference those product standards applicable to them.

Check your plumbing code to determine which materials and products may be used for each application, what product standards apply, and whether there are any special provisions regarding use of the materials. The following chart shows the general categories of piping applications of plastic piping materials covered by national consensus standards. Various manufacturers may exempt certain specific applications from these general applications categories. Thus, reference must be made to a manufacturer's application instructions before installing.

Plastic Pipe in Fire Resistive Construction

Plastic piping has been used extensively in residential, commercial, and industrial fire-rated construction throughout the US and Canada for decades. The plumbing codes reinforce the fire and building code provisions by requiring that all piping penetrations be made in such a manner as to maintain the integrity of the fire rating of building walls, floors, and ceilings.For additional information, contact PPFA for a copy of the *Plastic Pipe in Fire Resistive Construction* manual.

Conclusions

Information on the proper methods of installation for all types of plastic piping may not be included in all apprentice-training programs. Just as metals — copper, iron and aluminum — differ, so do the plastics — ABS, PVC, CPVC, PE, PP, PEX, PE-AL-PE, and PEX-AL-PEX. Just as metal alloys — brass, bronze, stainless steel, and cast iron — differ, so also can the plastics differ. Plastic products should be installed with the same care and precision workmanship that has been the standard of the plumber's profession from the beginning. Members of the Plastic Pipe and Fittings Association make installation and technical information on specific products available on their web site.

Remember, plumbing is just one application for plastic pipe. It is also used for chilled water-cooling systems, electrical conduit, environmental/groundwater sampling, buried LP gas piping, high and low head irrigation systems, water and sewer mains, water well casing, telephone duct, liners in high-pressure metal piping, hydronic heating, relining existing sewers, radiant heating, earth-coupled heat pumps, low-temperature heating/cooling systems, and directional drilling installations.

The PPFA Plumber's Installation Handbook was developed by the PPFA Technical Committee using the ballot process. The committee meets in cinjnction with ASTM F 17 sessions and invites comments from all active ASTM F17 members. Comments and suggestions concerning this information should be directed to the Technical Committee through PPFA offices.

	Plastic Material							
Piping Application	ABS	PE	PVC	CPVC	PP	PEX	SR	Composite pipe PEX-AL-PEX or PE-AL-PE
Drain waste & vent (DWV)	X		X					
Tubular waste	X		X		X			
Water piping	X	X	X	X		X		X
Hot & cold water distribution				X		X		X
Outside sewers & drains	X	X	X				X	
Septic fields - sub-soil		X	X				X	
Gas piping		X	X					
Chemical waste piping	X	X	X	X	X			
Industrial process piping	X	X	X	X	X			
Fire sprinkler piping			X		X			

DWV piping – general

A word of caution is essential: You must check your local plumbing code to be sure that the product you have chosen is approved by your code. Do not assume that every piping product sold by a supplier has been locally approved.

Whether you have chosen ABS-DWV, ABS-DWV cellular core, PVC-DWV or PVC-DWV cellular core piping, you have chosen a widely used product. These products, while made of different plastic materials, are similar in both installation procedures and service abilities.

Mixing ABS and PVC pipe and fittings within the same system is not recommended. However, joining ABS and PVC is possible when connecting building sewers to building drains. Consult your local code official and the product manufacturers for specific instructions.

DWV piping - storage and handling

Storage on the job site should always be on level support in a shaded area. If shade is not available, a suitable substitute, such as building felt or a tarp, should be used. Fittings should be stored in their shipping cartons or "rough" sorted into cardboard boxes. This will not only protect them from exposure to the sun but will help keep them clean. Pipe and fittings should be kept free of dust, dirt, and oil at all times.

DWV piping – marking

All PVC and ABS DWV pipe and fittings are marked with their respective ASTM standards for easy identification. In addition to the standards number, other markings will include the manufacturer's name and/or trademark, pipe size, the material (ABS or PVC), DWV, and the mark of a certification organization where required by codes.

Fittings markings vary slightly because of the limitation of space. They will normally be marked with the manufacturer's name and/or trademark, pipe size, the material (ABS or PVC), and the DWV symbol and certification marks.

The ABS-DWV and PVC-DWV markings apply only to Schedule 40 DWV and the 3.25-inch OD (Schedule 30) PVC-DWV piping. (Schedule 40 denotes an outside diameter and wall thickness equal, size for size, to the outside diameter and wall thickness of standard steel pipe.).

DWV piping - cellular core marking

ASTM F 628, Schedule 40 ABS-DWV pipe with a cellular core has the additional marking "COEX ABS CELLULAR CORE DWV". ASTM F 891, PVC pipe with a cellular core has the additional marking "IPS SCHEDULE 40 SERIES COEX CELLULAR CORE PVC-DWV."

DWV piping- coextruded composite marking

ASTM F 1488 pipe is marked with the series (ex. IPS SCHEDULE 40 SERIES) and the designation of the materials, starting with the outermost material (ex. ABS/CELLULAR PVC/ABS). ASTM F 1499 pipe is marked IPS SCH 40 along with the designation of the materials, starting with the outermost material (ex. ABS/PVC). Different combinations of ABS, PVC, and cellular ABS or PVC are permitted by both standards in two or three layers. Cellular core material may only be used in the middle layer of three-layer pipe.

DWV piping - dual marked PVC marking

Schedule 40 PVC DWV pipe is frequently dual marked for both DWV and potable water pressure pipe (ASTM D 1785 and ASTM D 2665). A dual marked PVC DWV and potable water pressure pipe can be triple marked for use as well casing with the addition of ASTM F 480. None of the other DWV pipes are pressure rated.

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DWV Piping - ASTM Standards

Material/Product	ASTM Standard	Title
ABS	D 2661	Acrylonitrile-Butadiene-styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
PVC	D 2665	Poly (Vinyl Chloride)(PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
PVC 3.25-inch OD	D 2949	3.25" Outside Diameter PVC Drain, Waste, and Vent Pipe and Fittings
Cellular Core ABS	F 628	Acrylonitrile-Butadiene-styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipewith a Cellular Core
Cellular core PVC	F 891	Coextruded Poly (Vinyl Chloride)(PVC) Plastic Pipe with a Cellular Core
Coextruded Composite ABS/PVC	F 1488	Coextruded Composite Pipe
Coextruded Composite DWV-PVC/ABS	F 1499	Coextruded Composite Drain, Waste, and Vent Pipe (DWV)

DWV Piping – cutting

Plastic DWV may be cut with pipe cutters, any crosscut saw, or a power saw equipped with a carbide tip blade or an abrasive blade. Special wheels made to cut plastic pipes are available for all standard cutters and lightweight, quick adjusting cutters designed exclusively for plastic piping are available.

A square cut is essential to insure joint integrity with socket fittings. Under no circumstances should you try to offset a solvent cement joint by bias cutting or deflecting the pipe. Use of a power saw on large jobs, or a miter box on small jobs, will insure consistently square cuts. If neither is available, scribe the pipe and cut to the mark. Do not attempt to force your saw. If the cut is not square, face it off with a file. Wipe away all saw and file shavings before applying cement to the pipe or fitting.

Pipe cutters should be sharp and well maintained. Cutters and cutter wheels previously used on metal should NOT be used. They exert excessive pressure, both internally and externally, causing larger shoulders and burrs that must later be removed. Pipe should always be reamed both internally and externally to remove burrs, shoulders, and ragged edges. External burrs can cause faulty joints. Several types of reamers and deburring tools are available for this purpose. Power reamers are available for shops or large projects, but a pocketknife or file can also be used.

DWV Piping - Joining

Solvent Cement Joining— General

Plastic PVC and ABS DWV pipe and fittings are generally joined with solvent cements that temporarily soften the joining surfaces. This brief softening period enables the installer to seat the pipe into the interference fit designed in the sockets of plastic fittings. The softened surfaces then fuse together. Joint strength develops as the solvents evaporate. When fully cured, the resulting joint is stronger than the pipe itself.

You will be referred to these joining instructions several times in this handbook.

With the exception of the priming step, the instructions for solvent cementing all types of

Material/Application	ASTM Specification	Title
ABS-DWV Pipe nd Fittings	D 2235	Solvent cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
PVC-DWV Pipe and Fittings	D 2564	Solvent Cemetns for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
PVC Primer*	F 656*	Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings*

* Some codes require the use of a primer.

PVC and ABS piping are similar.

In addition to these general solvent cement joining guidelines, there are additional guidelines specific to solvent cement joining of PVC and ABS piping.

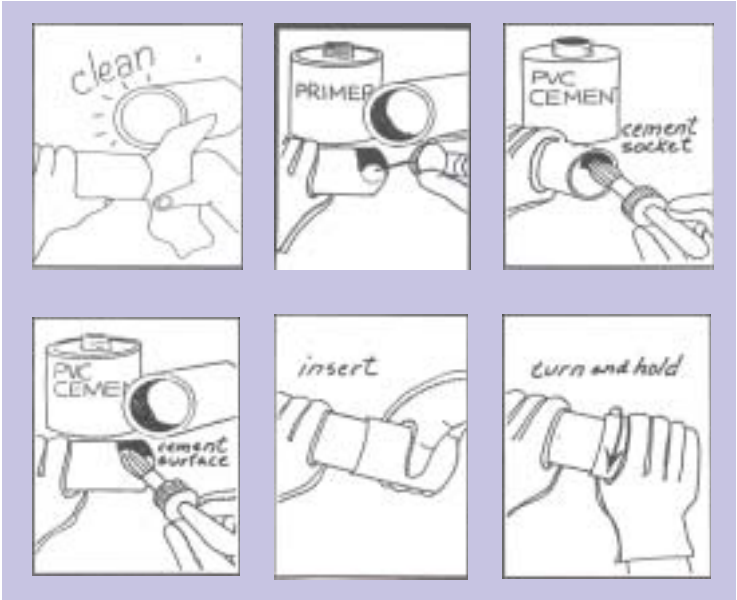
Since ABS and PVC DWV pipes are made from two completely different plastic compounds, each requires a different cement. Look for the correct standard numbers on the manufacturer's label before making the joint. Do not use combination cements, aerosol cements, or other cement types that do not meet these ASTM standards. The applicable ASTM standards of the cements and primers to be utilized with each of these plastic systems are as follows:

The selection of a proper applicator for applying cements and primers is important. Small cans of cement are usually equipped with a dauber affixed to the lid. For larger pipe sizes, natural bristle brushes or rollers should be used. The width of the brush or roller should always be at least ½ the diameter of the pipe being joined to assure sufficient application of the cement. Solvent cements for both ABS and PVC piping are available in 4 oz. to one-gallon cans. **Cement that is lumpy or too thick to flow easily should be discarded. Cans must be sealed when not in use as the cement quickly thickens and hardens. Do not use cements outside the temperature range recommended by the cement manufacturer.**

Before making a solvent cement joint in a plastic DWV system, the pipe and fittings must be clean and free of water, oil, soil or other debris. Also, success is assured only when interference fit exists between pipe and fittings. The pipe should make an interference fit with the fitting socket 1/3 to 2/3 into the socket when dry fitting the pipe.

Fittings to be aligned should be carefully marked for position before applying cement to assure proper alignment in the final assembly. Always use the proper fittings for making changes in direction. Do not place strain on pipe or fittings.

Do not attempt to heat and bend DWV piping.



The curing time required to achieve full joint strength will vary depending on the weather conditions, temperature and humidity, the pipe size, the application technique, the cement being used, and the degree of interference fit between pipe and fitting. All solvent cements do not react and cure the same. Some plastic pipe and fittings applications use solvent cements that require longer or shorter drying periods. Fast-, medium-, and slow-drying cements are available to assist in offsetting weather conditions.

Select the proper cement for whichever material you are installing and the use conditions (e.g., pipe size and temperature). Check for the material designation (e.g., ABS or PVC), the ASTM number, and for a certifying laboratory seal or mark on the can.

Water testing of DWV systems usually can take place within one hour after the last joint is made. These piping systems shall not be tested with compressed air or other gases unless the procedure being used has been clearly and specifically approved by the manufacturer(s) of the plastic product or system to be tested.

Note: By virtue of their compressibility, compressed air and gases contain large amounts of stored energy which present serious safety hazards should a piping system fail for any reason.

SAFE HANDLING OF SOLVENT CEMENTS, PRIMERS, AND CLEANERS

NOTE: Solvent cements, primers, and cleaners MUST be handled properly.

ASTM Standard F 402, *Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners* contains the following directions:

"Avoid prolonged breathing of solvent vapors. When pipe and fittings are being joined in partially enclosed areas, use a ventilating device as to maintain a safe level of vapor concentration with respect to toxicity and flammability in the work area. Select ventilating devices and locate them so as not to provide a source of ignition to flammable vapor mixtures."

KEEP CEMENTS, PRIMERS, AND CLEANERS AWAY FROM ALL SOURCES OF IGNITION, HEAT, SPARKS, AND OPEN FLAME.

Keep containers of cements, primers, and cleaners tightly closed except when the product is being used.

"Most of the solvents used in pipe cements, primers, and cleaners can be considered eye irritants and contact with the eye should be avoided as it may cause eye injury. Proper eye protection and the use of chemical goggles or face shields are advisable where the possibility of splashing exists in handling these products. In case of eye contact, flush with plenty of water for 15 min. and call a physician immediately."

"Avoid contact with the skin. Wear proper gloves impervious to and unaffected by the solvents when contact with the skin is likely. Application of the primers, cleaners, or solvent cements with rags and bare hands is not recommended. Brushes, daubers, and other suitable applicators can be used effectively for applying these products, thus avoiding skin contact. Dispose of used applicators in the same manner as the rags. In the event of contact, remove contaminated clothing immediately and wash skin with soap and water. Wash contaminated clothing before wearing them again."

Additional health and safety information is available on the manufacturer's Material Safety Data Sheet (MSDS).

Dispose of all rags and other materials used for mopping up spills in accordance with regulatory requirements. For additional information, review the MSDS for the product.

PVC-DWV - solvent cement joining

In addition to the above general solvent cement joining section, the following applies specifically to solvent cement joining of PVC pipes.

In the case of PVC-DWV, some codes require that a colored primer conforming to ASTM Standard F 656 be used prior to the application of PVC cement. CAUTION: DO NOT mix primer with cement in one container. Do not use cements that have gelled. Do not use so much cement or primer inside the joint that it leaves a puddle after assembly. The joining surfaces of both the pipe and the fitting should be wiped with a clean cloth to remove dirt and moisture. Apply the primer to the pipe and the fitting socket. Apply a heavy coat to the pipe and a thinner coat to the fitting socket. Immediately insert the pipe into the fitting socket turning the pipe 1/8 to 1/4 turn in the socket until it bottoms. This will help to obtain an even spread of cement. Be sure to align scribed marks on pipe and fittings at this point. Hold firmly for at least 15 seconds to prevent the pipe from "backing out" of the fitting. Wipe excess cement from the outside of the joint. Allow the joint to set properly vented to the atmosphere. Plastic pipe cements set up very rapidly; consult the cement manufacturer's instructions for curing times and other details. Some local codes may not require the use of primer. Be sure to check the requirements of the local codes and follow the instructions on the can of solvent cement for making the joint.

ABS-DWV - solvent cement joining

In addition to the above general solvent cement joining section, the following applies specifically to solvent cement joining of ABS pipes.

ABS-DWV joints are made in the same manner as PVC-DWV joints except that a primer is not used. The pipe and fitting surfaces must be clean and dry.

Cement should be applied smoothly and evenly. Apply a moderate coat in the socket and a heavy coat on the pipe. Excess cement is undesirable and should be wiped off; however, an insufficient amount can lead to a joint leak. The correct amount will give you an unbroken bead of cement all around the pipe against the fitting socket.

As soon as the parts are pushed together, the cement begins to set. Do not try to realign the pipe or fittings after setting begins. If you catch an error at this time, pull the pipe completely free and reapply cement as before. Should you turn the fitting after the setting has begun, the joint could be destroyed.

DWV piping installation - lay out

All plastic DWV fittings are of the drainage type and have built-in "Pitch" or "Fall". The skilled plumber will find it easy to layout, cut, and install plastic piping. **Unlike some piping, errors shall not be fixed by bending, with heat or a hammer.**

Do not take measurements with dry pipe inserted part way into the dry fitting sockets. Rather, measure to the full depth of the socket (right up to the 45-degree chamfer). Close tolerances between the pipe and fittings will stop the dry pipe from going to the full depth of the socket (if driven or forced in dry, it is very difficult to remove). Solvent cement lubricates and softens the pipe to permit "bottoming out" to the full depth every time. Thus, dry piece assemblies can "take up" as much as a quarter of an inch per fitting when finally assembled. This could cause errors on essential or critical measurements.

DWV piping installation – prefabrication

Plastic DWV lends itself to prefabrication as well if not better than any other material available because light weight and its strong joints permits the use of larger assemblies, thus reducing field joints to a minimum. Use jigs to assure accuracy and to speed up the job. A power saw with an adjustable stop will facilitate rapid cutting of pipe to proper lengths.

Shop-fabricated assemblies can be moved to the field soon after the last joint is made, or they can be stacked for future use.

CAUTION: Always check the dimensions of the first assembly carefully before proceeding with additional units.

DWV piping installation - supports

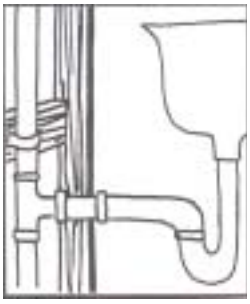
Plastic DWV should be supported as required by the code and in the same manner as any other piping system.

Split ring hangers, ordinary plumbers tape, or band iron may be used. Avoid wire that may cut or compress pipe and tight clamps or straps that prevent pipe from moving with expansion/contraction.

All branch lines to fixtures should be supported as near the fixture outlet as possible to maintain alignment. Fittings that will serve fixture outlets or trap arms should be anchored firmly so that they do not shift when the final connection is made. Follow natural alignment, avoid stress, and allow for thermal expansion of the piping.

Horizontal piping, through four-inch size, should be supported every four feet or as required by the local plumbing code. Supports should be added at changes of direction and large fittings to reduce stresses.

All DWV stacks should be supported at the base. Ensure that stacks do not touch sheet rock or panel walls to avoid setting up an echo chamber effect. DWV piping in walls or ceilings adjacent to living rooms or family rooms should be packed in insulation or wrapped to minimize water flow noises. Avoid binding pipe against wood supports that can lead to expansion noises.



DWV piping installation - transition connections

Schedule 40 Plastic DWV pipe should never be threaded because the wall thickness is reduced significantly by the process. Factory molded male threaded adapters that solvent cement to the pipe should be used where a threaded joint is required.

Codes require transition from one material to another only through use of approved adapters or joints. Your supplier should have a selection of plastic adapters. In addition, some codes approve clamped, flexible connectors or hubless couplings as adapters between cast iron and plastic piping.

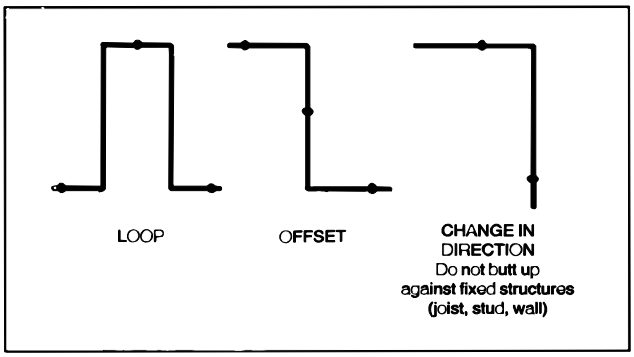
Some thread sealants may have an adverse effect on some plastics. Use only thread tape or thread sealants formulated for plastic piping. Thread sealants or plumber's putty are not necessary on P-trap union joints or slip joints since the threads do not provide the seal.

Joints between plastic pipe and cast iron hubs can be made with caulked lead wool. Although the plastic pipe can be set directly into a CI HUB, a plastic hub adapter is recommended. The hub adapter has a bead on the end of the spigot. This bead provides a seat at the bottom of the hub to retain the oakum in the joint. The joint should be filled with oakum as for metal pipe, and the lead wool caulked in the usual manner.

DWV piping installation - expansion / contraction

Allow for thermal expansion and movement in all piping installations. Determination of the amount of expansion or contraction should be based upon the difference between the temperature at the time of installation and the seasonal extremes in temperature. The linear expansion rate for ABS is approximately 5/8-in. for each 10º F temperature change for each 100-ft. of piping. The linear expansion rate for PVC is approximately 3/8-in. for each 10º F temperature change for each 100-ft. of piping. Regardless of pipe size, the linear rate remains the same.

The mechanical properties of ABS and PVC piping are such that more thermal stress can be absorbed than by other types of piping. This means expansion and contraction may have a minor effect on ABS and PVC piping once the building is completed and put in use, provided installation versus service temperatures and proper alignment are considered. With precise installation practices, the following methods can be employed to control expansion and contraction:



The use of properly designed offsets with piping properly guided through floors. Depending on operating temperatures encountered, offsets can be utilized as often as every other floor and as seldom as one per building.

The use of guides (in most instances, proper sleeve sizing and alignment) at every other floor, with anchors at the alternate floors for applications involving small temperature changes. As a general rule, this method can be employed in buildings of five stories or less.

Clamped flexible connectors or hubless couplings, where permitted by the plumbing code, have been used satisfactorily. For example, placed in risers between floors of tall buildings, expansion and contraction compensation has been achieved by leaving a 1/8-in. to 3/8-in. gap between the ends of the pipe within the flexible connector. This has been the standard method of installation in Europe for many years, where the "push-on" joining system is in universal use.

The use of expansion joints if approved by the plumbing code, properly adjusted to compensate for installation versus service temperatures, properly guided and properly anchored. Refer to expansion joint manufacturer's installation instructions.

temperatures, generally do not require special provisions.

Support but do not rigidly restrain piping at branches or changes in direction. Do not anchor pipes rigidly in walls, except where controlling the direction of expansion/ contraction. Holes through construction must be adequately sized to allow for free movement, except where otherwise designed for fire penetration protection. Hangers and straps must not compress, distort, cut, or abrade the piping and must allow free movement. Piping and joints must be properly installed, so as not to cause stress and strain.

DWV piping installation - concrete slab on grade

When DWV piping is to be encased in concrete, it should be filled with water and anchored to prevent floating and misalignment during the concrete pour. All openings should be capped or sealed against possible entry of concrete. The system should be checked immediately after pouring in order to correct any damage or misalignment before the concrete sets.

DWV piping installation - underground

For underground line installations, whether in a building drain, branch lines, or a sewer, good installation practices should be followed.

Grade all trench bottoms free of stone and pockets and for continuous, uniform support fill holes or depressions with clean, well-tamped material. Do not set pipe on bricks, concrete or wood blocks. Install pipe on proper grade with full, continuous support. Backfill along sides of pipe with selected fill free of stones, clods, or frozen lumps. Tamp backfill carefully to protect pipe alignment. Then backfill on top of pipe with selected fill (free of rock, stone, cement, and other hard materials) to a depth of 12 inches. The trench can then be backfilled in a conventional manner.

DWV piping installation - freezing

When it is necessary to protect traps and fixtures from freezing, do not use alcohol or petroleum products. Use only approved plastic pipe antifreeze packaged for this purpose or one of the following solutions:

- Sixty percent, by weight, of glycerin in water.
- Twenty-two percent, by weight, of magnesium chloride in water.
- Strong saturated solutions of common table salt (sodium chloride).

DWV Piping – other considerations

Air admittance valves (AAVs) - general

The air admittance valve is a product that simplifies drainage and waste venting in commercial and residential applications. It is a one-way valve designed to allow air to enter the plumbing drainage system when negative pressures develop in the piping system. The device closes by gravity and seals the vent terminal at zero differential pressure (no flow conditions) and under positive internal pressures. The purpose of an air admittance valve is to provide a method of allowing air to enter the plumbing drainage system without the use of a vent extended to open air and to prevent sewer gases from escaping into a building.

Installating air admittance valves

The AAV comes with an adapter that allows solvent welding on 1-1/2" or 2" pipes. The adapter meets the dimensional requirements of pertinent ASTM standards and is suitable for installation on PVC or ABS pipes. Apply Teflon ® tape to threads on valve before joining. Do not use pipe dope.

The AAV must be installed in a vertical plumb position after rough in. It shall be installed a minimum of 4" (102 mm) above the horizontal branch of the drain or fixture drain being vented and in accessible locations which permit free movement of air into the valve. For example, under a sink or lavatory, in attic spaces, in a plumbing case, in a false ceiling or wall by using a recess box.

When installed in an attic, the AAV must be a minimum of 6" above insulation material.

For installation in areas with temperature range from -40º F and +150º F a minimum of one open pipe vent shall extend to the open air for every building plumbing drainage system.

Water Service Piping

Water Service Piping - general

A word of caution is essential: You must check your local plumbing code to be sure that the product you have chosen is approved by your code. Do not assume that every piping product sold by a supplier has been locally approved.

Plastic water piping usage has been increasing since the 1950's in this country and around the world. This can be attributed to code acceptance, and excellent performance along with economics.

"Water Service Piping," as used in this section, refers to the cold-water service line from the water meter, water main, water well, or street right-of-way to the house or building. It is not intended to cover either water mains or the distribution piping within the building.

Plastic water service piping is available in PE (polyethylene), PVC (polyvinyl chloride), PEX (cross-linked polyethylene), CPVC (chlorinated poly vinyl chloride) and PE-AL-PE composite. Depending on the type of material and product selected, the available pressure ratings range from 80 psi to over 315 psi. Actual pressures encountered are usually between 35 psi and 125 psi. However, population growth and extensions of municipal water systems tend to require constantly increasing pressures. The pipes selected should have some allowances for increases in pressure. Many plumbing codes and water utilities require a minimum of 160 psi pressure rated pipe for water service piping connected to municipal water systems.

PVC and CPVC pipe are referred to as "rigid" and are shipped in straight lengths. Smaller sizes of CPVC are also available in coils. PE, PEX, and composite pipe are referred to as "flexible" and are normally shipped in coils.

Because there are several kinds of plastic piping designed for and suitable for water service piping, a variety of joining methods are used. For additional information regarding the joining of specific materials, please see the *Handbook* or the manufacturer's instructions for that specific material.

The installer must exercise care in selecting the proper material for the application. All plastic piping is economical. Local codes, availability, and local practices typically govern the choice of piping material and product standard.

Water Service Piping - storage and handling

Flexible piping (PE, PEX, and composite) is normally shipped in coils that are available in 100-foot increments. Coils can be stacked up to ten high without crushing or damaging. Coils should never be allowed to be exposed to fire or excessive heat. During installation, do not drag the piping over rough terrain and avoid contact with sharp objects that could gouge or cut the piping.

Rigid piping (ABS, PVC, and CPVC) is normally available in 10' and 20' lengths. CPVC is also available in 50' and 100' coils.

Most plastic pipe should be stored inside or under cover. However, some materials such as UV stabilized PE do not require inside storage. See manufacturer's instructions for details.

Water Service Piping - marking

Markings on plastic water pipe should comply with the requirements of the respective standard under which the particular piping is manufactured. Generally, the standards require that the pipe marking be spaced at intervals of not more than 24 inches on some pipes and 5 feet on other pipes. Water piping standards require marking only on one side of the pipe.

Most standards require that the markings include:

1. Manufacturer's name or trademark and production code
2. The ASTM pipe, fitting, or system standard number
3. Type of plastic material and its ASTM designation
4. Nominal pipe (or tube) size
5. Schedule (40, 80, 120) or SDR
6. Pressure ratings at 73 ºF (or other temperature)
7. The seal or mark of the laboratory that evaluates the product for use in potable water systems
8. For ASTM D 2239 Pipe Test Category marking required

Water Service Piping – ASTM Standards

PE (Polyethylene) Piping - ASTM Standards

Product	ASTM Specification	Title
Pipe and Tubing	D 2239	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
Pipe and Tubing	D 2447	Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside diameter
Pipe and Tubing	D 2737	Polyethylene (PE) Plastic Tubing
Insert Fittings	D 2609	Plastic Insert fittings for Polyethylene (PE) Plastic Pipe
Butt Fusion fittings	D 3261	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipeand Tibing
Electrofusion Fittings	F 1055	Electrofusion Type Polyethylene fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

PE-AL-PE Composite - ASTM Standards

Product	ASTM Specification	Title
Pipe	F 1282	PE-AL-PE Composite Pressure Pipe

PEX (Cross-linked Polyethylene) Piping - ASTM Standards

Product	ASTM Specification	Title
Pipe and Tubing	F 876	Crosslinked Polyethylene (PEX) Tubing
Pipe and Tubing	F 877	Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution sSstems
Insert fittings	F 1807	Metal Insert fittings Using a Copper Crimp Ring for SDR9 Crosslinked Polyethylene (PEX) Tubing
Insert fittings	F 1960	Cold Expansion Fittings with PEX Reinforcing rings for Use with Crosslinked Polyethylene (PEX) Tubing

* ***Some codes require the use of a primer***

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PVC (Polyvinyl Chloride) Piping ASTM Standards

Product	ASTM Specification	Title
Pipe (1120, 1220, 2120)	D 1785	Poly (Vinyl Chloride) (PVC) Schedules 40, 80 and 120
Pipe (PVC 1120, 1220, 2120)	D 2241	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
Fittings	D 2464	ThreadedPoly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
Fittings	D 2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
Fittings	D 2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
Solvent Cement	F 493	Solvent Cement Systems for Poly (Vinyl Chloride) (PVC) Plastic Piping systems
Primer*	F 656*	Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and fittings*

CPVC (Chlorinated Polyvinyl Chloride) ASTM Standards

Product	ASTM Specifications	Title
Pipe and Fittings	D 2846	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
Fittings	F437	Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe fittings, Schedule 80
Fittings	F439	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80a
Pipe	F 441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
Solvent Cement	F 493	Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
Primer*	F 656*	Primers for Use in Solvent Cement Joints of Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings*

Water Service Piping – Cutting

Cutting PE, PEX & PE-AL-PE

A plastic tubing cutter is recommended for a square, clean cut. Many tool manufacturers now feature inexpensive cutters specifically designed for cutting plastic piping. Do not use cutters previously used on metal piping.

Cutting PVC and CPVC

A plastic pipe cutter or a power cut-off saw should be used for a clean, square cut. If a wheel type cutter is used, remove the ridge created by the wheel and provide a chamfer with a tool or a file. If other cutters are not available, cuts can be made with a handsaw or hack saw. Use a miter box or scribe and cut to the mark for a square cut. Never depend on "eye-balling" for a square cut.

Joining PE, or PEX or PE-AL-PE

PE piping is joined by heat fusion or mechanical fittings. PEX and PE-AL-PE piping are generally joined with mechanical fittings. *However, none of this piping can be joined by solvent cementing.*

Connecting to a corporation stop or curb stop is simple and easy with flexible plastic piping. It can be done with compression fittings, insert fittings using clamps, or a stab-type fitting.

First, affirm that the fitting is recommended by the manufacturer for connecting PE, PEX or PE-AL-PE water piping. Care must be used to match the sizing of the fittings to the pipe or tubing you are using. This is best done by matching the sizing on the pipe print line with the fitting's label. In using insert or compression fittings, consult the installation instructions of the particular manufacturer whose fittings you are using. Stab-type mechanical fittings designed for PE and PEX water piping are of a one-piece design that simplifies installation.

Compression type mechanical connectors include insert fittings with crimp or band-type rings, nut-follower style, flanged bolted and stab-type fittings. Insert fitting joints utilize insert fittings with male barbed ends. Insert crimp/band type or nut-type mechanical couplings with rigidly positioned stiffeners that extend beyond the clamp or coupling nut should not be used unless provisions are made to prevent the creation of a stress riser at the end of the stiffener.

Heat fusion uses a combination of heat and force resulting in two melted surfaces flowing together to produce a joint. Commonly available fusion machines provide the means for truing pipe ends, holding them in alignment, heating them, and applying the correct force to produce a satisfactory joint. Once the joint has cooled to ambient temperature, it can be handled in the same manner as the pipe.

Joining PVC or CPVC

Rigid, PVC and CPVC pipe and fittings for water service lines are solvent cemented employing the techniques described in the Solvent Cement Joining section of this *Handbook*. All systems require care during assembly to assure leak-free joints.

Plastic threaded fittings are only intended to be attached to other plastic threaded fittings. Systems that involve transitions from metal to plastic require careful attention. Several styles of adapters have been specially developed to provide leak-free transitions to metal piping. Some of these include: plastic/metal unions, reinforced female threaded adapters, and flanges. When assembling metal and plastic threads, the preferred method is plastic male threads to metal female threads.

If transitions from metal to plastic are exposed to fluctuations in temperature, then cyclic heating and cooling may result in dripping links. In this situation, do not use plastic male threads to metal female threads. Instead use plastic/metal unions, plastic to metal transition fittings, or plastic to metal flanges.

Before assuming that a fitting is appropriate for use as a metal to plastic transition fitting, be sure to check with the specific manufacturer for suitability. Once contacted, manufacturers can also give advice on how their transition products will behave under different operating conditions (e.g., some products might be better suited to large swings in temperature than others).

The recommended tightness for plastic pipe threads is two turns past finger-tight; over tightening may result in split fittings. Do not use pipe wrenches or other tools, which would damage plastic pipe and fittings. When gauging plastic threads, they are within the permissible tolerance if not more than 1-1/2 turns large or small.

When making threaded connections, conventional joint sealers such as solder flux, linseed oil based products, putty, and other unknown mixtures shall not be used. Use only Teflon® tape or recommended thread sealants based on specific manufacturers' recommendations.

See the Solvent Cement Joining section on pages 4-6 of this Handbook for specifics on joining and safe handling of solvent cements, primers and cleaners.

Water Service Piping - installation

General installation

This section addresses the various methods of installing plastic water service piping and should be used in conjunction with the more detailed, material specific guidelines below. Specific installation guides are available from the manufacturers of particular products.

Compression type mechanical connectors may have several internal parts and should be used only as recommended by the manufacturer for plastic water piping applications. Compression type mechanical connectors include insert fittings with crimp or band-type rings, nut-follower style, flanged bolted and stab-type fittings. Crimp or nut-type mechanical couplings with rigidly positioned stiffeners that extend beyond the clamp or coupling nut should not be used unless provisions are made to prevent the creation of a stress riser at the end of the stiffener. All stiffeners should be "nosed" or rounded at the end and all sharp edges or burrs must be removed. Bridging or support sleeves are one method of preventing undue stresses on the plastic pipe at the end of the stiffener. Stab-type mechanical water fittings with self-contained insert stiffeners are designed to mitigate any stress risers when properly installed on PE and PEX piping.

The installer should also make sure that the fitting and pipe are both based on the same dimensioning system, (i.e., Outside Diameter Control or Inside Diameter Control and IPS or tubing sizes). The best way to assure correct dimensioning is to match the print line on the pipe to the fitting label.

Full knowledge of installation procedures is important. For more details, see ASTM D 2774, Standard Practice for Underground Installation of Thermoplastic Pressure Pipe. Additional information regarding the design, installation, and operation of plastic piping is available from the Plastic Pipe and Fittings Association as well as other sources within the industry.

When installing or repairing water service lines, cleanliness helps prevent contamination that must be corrected by disinfection.

When disinfecting new or repaired water mains, services, and distribution systems, the methods and procedures found in ANSI/ AWWA C 651 and the manufacturer's instructions are recommended. NOTE: Do not exceed the piping manufacturer's disinfection instructions without consulting the manufacturer.

Installating PE, PEX and PE-AL-PE

In addition to the above general installation guidelines, the following guidelines are specific to these Water Service Piping products.

Piping should be installed on trench bottoms that provide continuous support and are uniform and free from rocks, stones, or other debris. Initial backfill around the piping should be clean fill, and should be well tamped to provide adequate piping support. Ditches should be well tamped to prevent settling.

Ditches may be curved to avoid obstructions, but the radius of curvature should not be smaller than that recommended by the manufacturer to avoid pinching or crimping the piping.

Plastic water service piping expands and contracts more than metal piping, so the piping should never be pulled tight or stretched for connection. Allow an extra 6 inches per 100 feet for expansion and contraction by snaking the piping from side to side in the trench. This is easily accomplished with flexible piping.

CAUTION: Depth of burial should always be at least 12 inches below the local frost depth and in all cases at least 18 inches below the surface to protect the piping from traffic loads. While PE and PEX plastic piping are not as subject to damage by freezing as metals, they are somewhat more difficult to thaw once they are frozen. Never use an open flame to thaw plastic piping. Thawing can be accomplished by using thermostatic controlled (160º F) electric heat tapes, by using hot air, or by disconnecting the line and

flushing with hot water. This will usually clear the stoppage.

Water Service Piping -helpful hints for PE, PEX and PE-AL-PE

REMEMBER, you can avoid problems by:

1. Protecting the piping from damage before installation.
2. Inspecting piping for cuts and damage before installation and rejecting damaged piping.
3. Never permitting rocks and sharp objects to bed against piping.
4. Never "reverse bend" coiled piping.
5.I nstalling piping without placing stress on fittings.
6. Never permitting plastic piping to be kinked or installed under strain at a metal fitting.
7. Snaking the piping in the ditch to allow for temperature differences.
8. Flushing the line free of dirt before the final connection.

9. Filling the line with water and pressure testing before back filling. Test to t he pressure required by the code or to 150% of working pressure.

Installing PVC and CPVC

In addition to the above general installation guidelines, the following guidelines are specific to PVC and CPVC_Water Service Piping.

Most of the trenching, testing, and freeze protection procedures outlined in the previous section on flexible plastic water service materials also apply to rigid piping.

Snaking the line to provide for expansion and contraction is somewhat more difficult than with flexible piping and requires a little more effort, but even rigid pipe has enough "yield" to accomplish this.

After the main portions of the line have been run and the "set" of the joints is assured, stakes can be placed along the piping between the couplings to accomplish the desired snaking. Never place a stake at a coupling. This may cause stress or strain that could damage the joint. After measuring and fitting the last piece of the line, the stakes can be pulled up for reuse. Never run a plastic water service line perfectly straight and tight. Damage or pull out could result when expansion or contraction takes place.

The rigid piping should be laid on a trench bottom free of rocks or sharp objects. Since rigid piping will involve more joints that could be damaged, the service line should be installed in a protective "envelope" of fine soil and at least 6 inches of cover should be provided before backfilling with mechanical equipment.

Leave line pressure in the service line while backfilling. If any leak occurs, it will be easy to find. This will save the labor of digging out more of the line. Should a leak occur, review your joint assembly and installation practices carefully. Allow the repaired joint to cure for the required time period, or you may find yourself repairing it again.

Too often, careless backfilling results from assigning the job to someone else. Remember that the responsibility for the service line is yours. Supervise the installation until it is completed to your satisfaction.

Water Service Piping - Helpful Hints for PVC and CPVC

REMEMBER: You can avoid problems if you:

1.Wipe all parts clean and dry before assembly.

2. If required by code and/or manufacturer's instructions use a primer with PVC rigid piping.

3. Use the proper cement for the type of pipe you are joining.

4. Exercise care with each joint to reduce the possibility of leaks.

5. Allow sufficient drying or curing time before testing. This will depend on the weather, type of material, humidity, pipe size, and type of cement. Joint strength increases with time. Check manufacturer's recommendations.

6. Pressure test with water as required by code or at 150% of the working pressure. Apply pressure long enough to detect leaks but no longer than 24 hours. Do not test with compressed air or gas.

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Hot & Cold Water Distribution Piping

Hot and Cold Water Distribution - General

A word of caution is essential: You must check your local plumbing code to be sure that the product you have chosen is approved by your code. Do not assume that every piping product sold by a supplier has been locally approved.

Hot and Cold Water Distribution Piping – General Properties

The plastic industry offers three complete systems for hot and cold-water distribution systems: CPVC (chlorinated polyvinyl chloride), a rigid system; PEX (cross-linked polyethylene), a flexible system; and PEX-AL-PEX or PE-AL-PE (composite) flexible systems. They are approved by most model, state, or local codes. However, we do recommend that the installer verify this approval and the code requirements before beginning installation. For clarity, these systems are dealt with separately.

Plastic water pipe and tube is more resistant to freezing than metal pipe. However, in the event of freezing, blow torches or open flames must never be used for thawing. Use a low temperature hot air gun, circulate warm air with a fan, or thaw by disconnecting the line and flushing with warm water. Afterwards, test the system with water at the pressure required by the code or at 150% of the working pressure.

NOTE: Polybutylene (PB) piping is no longer available in the USA for water distribution piping. There is a special section at the end of this chapter offering polybutylene-specific guide material.

CPVC Properties

CPVC CTS (copper tube size) pipe and fittings, introduced in 1960, are manufactured to conform to ASTM D 2846. CPVC solvent cement conforming to ASTM F 493 is used to join the pipe and fittings. CPVC piping is tan in color, is made with the same OD as copper water tubing and has proven its ability to do its designated job. It resists corrosion, reduces sweating, has adequate impact strength, has smooth walls that give low flow resistance, is lightweight, and is easy to install.

Cost considerations and corrosion problems with metal systems have led many plumbing contractors to turn to this field-proven product. They have found it to be excellent for domestic hot and cold water distribution systems and for circulating hot water systems.

PEX Properties

PEX tubing can be used in potable water distribution systems. PEX tubing is also widely used for heat transfer applications – both low-temperature (radiant floor heating, snow removal, and ice rinks), as well as distribution piping for temperatures up to 200° F (hot water baseboard, convectors, radiators, etc.).

PEX-AL-PEX or PE-AL-PE Properties

Composite pipe has an aluminum tube laminated between two layers of plastic-PE or PEX. It is made to tube dimensions and is sold in coils. The PE-AL-PE (ASTM F 1282) is dark blue in color and is used for cold water. The PEX-AL-PEX (ASTM F 1281) is orange, light blue or black in color and is used for hydronic heating and hot water. The pipe is supplied with fittings and accessories that complete the system.

Hot and Cold Water Distribution Piping - Storage and Handling

CPVC CTS piping is available in 10' or 20' lengths and 50' and 100' coils. It should be stored inside or under cover to prevent an accumulation of dirt. Short-term exposure to direct sunlight (not to exceed 30 days total time) can be tolerated during construction. Pipe should be stored straight with continuous support over its entire length. Handle carefully to ensure that the pipe stays clean, ends are unchipped and square and abrasion is avoided.

PEX piping and composite piping (PE-AL-PE or PEX-AL-PEX) are normally shipped in coils that are in 100' increments. Coils can be stacked up to ten high without crushing or damaging. Coils should never be allowed to be exposed to fire or excessive heat. During installation, do not drag the piping over rough terrain and avoid contact with sharp objects that could gouge or cut the piping.

Most plastic pipe should be stored inside or under cover. However, some UV stabilized piping products do not require inside storage. See manufacturer's instructions for details.

Hot and Cold Water Distribution Piping - Marking General

Markings on plastic water pipe should comply with the requirements of the respective standard under which the particular piping is manufactured. Generally, the standards require that the pipe marking be spaced at intervals of not more than 24 inches on some pipes and 5 feet on other pipes. Water piping standards require marking only on one side of the pipe.

Marking CPVC

In addition to the general requirements, the following are CPVC specific requirements.

CPVC pipe is required by ASTM D 2846 to be permanently marked on one side of the pipe at intervals not exceeding five feet.

This marking shall include the following:

1. Manufacturer's name or trademark
2. ASTM Designation D 2846
3. Material Designation Code (CPVC 4120) or 23447
4. Pressure Rating – 100psi @ 180° F
5. Nominal Size
6. Standard Dimension Ratio-SDR 11
7. The seal or mark of the third party certifier that evaluates the product for use in potable water systems and for conformance with the D 2846 Standard. Fittings markings should include at least (1), (2), (3), and (7) of the above information. Transition fittings must be marked with (1), (3), and (7) of the above information.

Marking PEX

In addition to the general requirements, the following are PEX specific requirements.

PEX tubing must be labeled as follows:

1. The manufacturer's name or trademark.
2. The standard to which it conforms (ASTM F 876, F 877 or both).
3. The tube size and CTS.
4. Material designation code (PEX0006).
5. Pressure/temperature rating(s).
6. SDR9
7. If the tubing is for potable water, a laboratory seal or mark attesting to suitability for potable water.
8. ASTM Standard designation for the fitting system for which the tubing has been approved for use.

Marking PE-AL-PE or PEX-AL-PEX

In addition to the general requirements, the following are composite pipe specific requirements:

1. The manufacturer's name or trademark
2. The standard to which it conforms (ASTM F 1281 or F 1282)
3. The tube size in metric (mm) or inch sizes (1216 ~1/2"; 1620 ~ 5/8"; 2025 ~¾"; 2532~1")
4. The material designation (PEX-AL-PEX or (PE-AL-PE)
5. Pressure temperature rating (PEX-AL-PEX) 200 psi @ 73°F & 125 psi @ 180°F
6. Pressure temperature rating (PE-AL-PE) 200 psi @ 73° F & 160 psi @ 140° F
7. A laboratory seal or mark attesting to suitability for potable water and conformance with the standard marked on the pipe.

Hot and Cold Water Distribution Piping - Cutting

Cutting CPVC

A plastic pipe cutter or power cut-off saw should be used for a clean, square cut. If a wheel-type tubing cutter is used, remove the ridge created by the wheel and provide a chamfer with the appropriate tool or file. If other cutters are not available, cuts can be made with a handsaw or hack saw. Use a miter box or scribe and cut to the mark for a square cut. Never depend on "eye-balling" for a square cut.

Cutting PEX & PEX-AL-PEX or PE-AL-PE

A plastic pipe cutter or a power cut-off saw should be used for a clean, square cut. If neither is available, cut with a handsaw or hack saw. Use a miter box or scribe and cut to the mark for a square cut. Never depend on "eye-balling" for a square cut.

Hot and Cold Water Distribution Piping – Joining

Joining CPVC

CPVC pipe and fittings are joined with CPVC cements. The solvent cement process can be a one- or a two-step process. The one-step cement does not require the use of a primer or cleaner; this cement is yellow in color. The two-step process does require the use of a primer or cleaner; this cement is orange in color. Both types of cements are manufactured under the ASTMF 493 Standard and will be marked with that number. The label on the can will indicate color and whether a primer is required. The label may also refer to D 2846.

See the Solvent Cement Joining section in this Handbook on pages 4-6 for specific solvent cementing instructions.

Use only CPVC cement and follow the cement manufacturer's recommendations in selecting and using the primers and cements. All other conditions of cementing CPVC are identical to those of PVC DWV and PVC water piping, including safe handling of solvent cements, primers, and cleaners. Make sure that the local code allows the use of one step cement before using it.

Joining PEX

A full line of directional and transition fittings is available. The joint can be formed by various methods including mechanical compression, insert fittings using a copper crimp ring (ASTM F 1807), cold expansion

fittings using a PEX reinforcing ring (ASTM F 1960), and mechanical stab joints.

In manifold systems, one-piece PEX tubing is installed between the centrally located manifold and the fixture connection, thus the only joints are at the ends of the tube. Only a few additional joints are needed to complete the supply line to the header.

Joining PEX-AL-PEX or PE-AL-PE

A full line of directional and transitional fittings is available. Two types of joints are available, mechanical compression and crimp ring. Metal fittings are the norm. In manifold systems, a single piece of the tube is installed between the manifold and the fixture so the only joints are at these two accessible locations

Hot and Cold Water Distribution Piping – Installation

Installing CPVC

The installer is cautioned to:

1. Read and follow the manufacturer's recommendations.
2. Wipe joint surfaces clean and dry.
3. Use a primer before cementing with orange cement. Alternatively, use the yellow cement without a primer if local plumbing codes permit.
4. Use only CPVC solvent cement.
5. Hold the pipe and fitting joint together for at least 15 seconds after assembly.
6. Never bind piping.
7. Allow joints to cure, flush out the system, and pressure test with water as required by code.

A CPVC Hot & Cold Water Piping Installation Manual containing more information on the use of CPVC, is available from PPFA.

Installing CPVC – metal connections

Adapters (transition fittings) from metal piping to CPVC are available. These fittings come in the form of unions, compression fittings, and reinforced male and female threaded adapters. When water temperatures exceed 150° F, use brass threaded transition fittings only. Use the manufacturer's recommended fittings for transition to other piping materials and follow instructions for proper installation. When making threaded connections with CPVC fittings, conventional joint sealers, solder flux, or other components should never be used on plastic threads. Use only recommended thread sealants or Teflon® tape. When threaded plastic fittings are used, make sure they are not over-tightened.

Common pipe wrenches will bite or score plastic fittings. Flat, smooth-surfaced adjustable wrenches, open-end wrenches, or smooth pliers should be used to tighten fittings.

When connecting CPVC to inlets and outlets at the top of a gas water heater, provide at least twelve (12) inches of metal nipple or appliance connector so that the CPVC cannot be damaged by the buildup of excessive radiant heat from the flue. CPVC piping should not be in contact with, or close to, heat-producing sources such as flues or steam pipes. Some high-efficiency, direct-vent gas water heaters eliminate the radiant heat from the flue and the CPVC pipe connections can be made with brass threaded CPVC transition fittings.

Installing CPVC - Supports

For 180° F service, CPVC should be supported at three feet maximum spacing for sizes one-inch and smaller, and at four feet maximum spacing for larger sizes. For 73° F service, the support spacing can be increased by 50 percent. It should be strapped or hung in a manner that will permit movement caused by expansion and contraction. Do not fasten tightly to studs or joists. Hangers should have a smooth surface to prevent cutting or abrading the piping.

Installing CPVC - Expansion and Contraction

The linear thermal expansion rate for CPVC is approximately 7/16 inch for each 10º F temperature change for each 100 feet of pipe or tubing. When installing long runs of piping allow 1/16 to 3/32-inch longitudinal clearance per foot of run to accommodate thermal expansion. Proper design includes offsets of 12 inches or more at intervals as required on vertical risers, if they are restrained by horizontal branches. Piping should not be anchored rigidly to a support, but it should be secured with broad, smooth hangers providing for a degree of movement. Refer also to manufacturer's literature and the local plumbing code. CPVC is approved for underslab installations, with joints, in all model-plumbing codes.

Installing CPVC - freezing

Like other plastic water pipe and tube, CPVC is more resistant to damage by freezing than are metals. However, in the event of freezing, blow torches or open flames must never be used for thawing. Use a low temperature hot air gun, circulate warm air with a fan, or thaw

by disconnecting the line and flushing with warm or hot water. After flushing, test all systems with water at the pressure required by the code or at 150% of the working pressure.

Installing PEX or PEX-AL-PEX

The installer is cautioned to read the manufacturer's installation instructions for proper installation practices. In all cases, normal workmanship is required if a long-term satisfactory installation is to be achieved. Do not use tubing that has been cut, severely scuffed, kinked, or crushed. Cut and replace damaged sections.

The tubing must be placed so that it will not be exposed to sources of high heat. Keep the tubing at least 6-inches horizontally and 12-inches vertically from fluorescent and incandescent light fixtures, heating appliances, and furnace or water heater flue vents.

PEX tubing should not be directly connected to gas or electric water heaters. Use a minimum of 18-inch length of metallic pipe for each connection. However the PEX-AL-PEX tube can be connected directly to both types of water heaters.

When making transition fittings to copper or brass pipe or fittings by soldering or brazing, do the soldering first, and allow the joint to cool before making the connection to the tubing. Do not expose the tubing to an open flame as damage can result.

Installing PEX – Supports

PEX tubing is usually supported on the face of, or by holes through, joists or studs. Otherwise, support horizontal piping above ground every 32 inches using hangers wide enough to avoid deforming the tubing at the point of support. Sharp edges must be avoided. Typical clevis hangers or one-hole or two-hole clamps ranging from about 3/8 inches to 1 inch are usually suitable. Clamp tubing firmly, but not so tightly that it cannot move as it expands and contracts.

PEX piping run vertically should be supported mid-story and at every floor level and again when making significant changes in direction.

Installing PE-AL-PE and PEX-AL-PEX-Supports

This tubing comes in coils but when it is uncoiled there is no spring-back. The tube can be bent by hand and the minimum radius is 5 X Diameter. For 1" tube, use a bending tool. Although the maximum support spacing for this tubing is 8' 2", the plumbing code may require closer support spacing. Plastics clamps are recommended and clamps should be provided at changes in directions.

Installing PEX – expansion and contraction

PEX piping will expand and contract about 1 inch for every 100 feet of length for each 10° F change in temperature. For tubing sizes 1 inch and smaller, this length change is accommodated by snaking tubing around obstacles and by normal slack that is present in laying flexible pipe. For those cases where significant temperature variation is expected, piping dimensional change can be accommodated at changes in direction or with offsets or loops.

Installing PE-AL-PE and PEX-AL-PEX-expansion and contraction

This tubing has a coefficient of linear expansion similar to copper tubing. Therefore no special provisions are needed to compensate for the temperature changes that typically occur in hot and cold water distribution systems.

Installing PEX - freezing

Like other plastic water pipe and tube, PEX is more resistant to damage by freezing than are metals. However, in the event of freezing, blow torches or open flames must never be used for thawing. Use a low temperature hot air gun, circulate warm air with a fan, or thaw by disconnecting the line and flushing with warm or hot water. After flushing, test all systems with water at the pressure required by the code or at 150% of the working pressure.

PB (PolybutyleneGuidelines

Polybutylene (PB) is no longer offered for use in North America. The pipe was sold primarily in coils from 1970-1995. You may encounter some in structures built or remodeled during that time frame. The majority of product would be gray in color and be found in single-family structures, apartments, and mobile homes.

PB piping was made to the following ASTM Standards for these applications:

- ASTM D 3309 -Hot & Cold Water Distribution- This was copper tube size (CTS) piping mostly coiled but also available in straight lengths. It was gray in color. This PB piping was also used for fire sprinkler systems, and for radiant slab heating systems. PB piping was used in many mobile homes and in some pre-fabricated housing.
- ASTM D 2513 -Natural Gas- This was CTS size PB piping (gold or black) used for underground

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distribution or service lines and was installed by some gas companies.

- ASTM D 2666 - Water Service Lines. This was CTS size PB piping (black or blue) used for lines from the water main to the meter and to the building. ASTM D 2662, ID controlled PB pipe, was also used for water service lines.
- ASTM D 2666 and D 2662 - Almost all PB water service lines were made to the D 2666 specification, in black or blue grades. They were used in main to meter or meter to house applications.

Storm and Sanitary Sewers and Drains

Storm and Sanitary Sewers and Drains-General

A word of caution is essential: You must check your local plumbing code to be sure that the product you have chosen is approved by your code. Do not assume that every piping product sold by a supplier has been locally approved.

Storm and sanitary sewer pipes are covered by ASTM standards D 2729, D 2751, D 3034, F 789 and F 891. While these products are now acceptable in most areas, the user still must check the local code.

This section will deal with house and building sewers on private property, outside buildings. For the sake of brevity, only normal depth and installation will be discussed. In addition to plastic piping for sanitary sewers, the plastic industry makes lighter wall piping suitable for clear water drainage and foundation drains. (Note: for storm water and roof drains within the building, most codes will also permit the use of the approved DWV products).

For those who do septic tank work, perforated drainpipes made from SR (styrene rubber), PE (polyethylene), and PVC (polyvinyl chloride) are available. Again, we caution the installer to refer to his local plumbing code to determine which materials and which products are approved for use.

Each of the noted standards includes both the pipe and the fittings designed to be used in the system. Mixing the pipe meeting one standard with fittings meeting another standard is not recommended. Note that DWV piping and sewer/drain piping use different outside diameters for each pipe size. Check the markings on both pipe and fittings.

Storm and Sanitary Sewers and Drains - Marking

Sewer and drain piping is identified in a similar manner as DWV piping. See

DWV Piping - Marking section on page 8 of the *Handbook*, for typical marking requirements.

Storm and Sanitary Sewers and Drains- ASTM Standards

PPFA

ASTM Standards for ABS and PVC Storm and Sanitary Sewer Pipe and Drain Piping

Material/Application	ASTM Specification	title
ABS Drains	D 2751	Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
PVC Type PSM Sewer	D 3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
PVC Type PS-46 Sewer	F 789	Type PS-46 and Type PS-115 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings
PVC Coex Sewer	F 891	Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
PVC Drain	D 2729	Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM Standards for PE and PP Sewer Pipe and Drain Piping

Material/Application	ASTM Specification	Title
PE Corr Drain	F 405	Corrugated Polyethylene (PE) Pipe and fittings
PE & PP Drain	F 1412	Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems

Storm and Sanitary Sewers and Drains – Cutting

Cutting ABS and PVC

A plastic pipe cutter or a power cut-off saw should be used for a clean, square cut. If neither is available, cuts can be made with a hand saw or hack saw. Either a miter box or scribing and cutting to the mark should be used for a square cut. Never depend on "eye-balling" for a square cut.

Cutting PE and PP

A plastic tubing cutter is recommended for a square, clean cut. Many tool manufacturers now feature inexpensive cutters specifically designed for cutting plastic piping. Do not use cutters previously used on metal piping.

Storm and Sanitary Sewers and Drains – Joining

Joining ABS and PVC

Plastic sewers may be joined either by solvent cementing or with elastomeric seal joints. Consult the DWV solvent cementing portion of this Handbook on page 11 for specifics on solvent cement joining and safe handling of solvent cements, primers and cleaners.

Joining PE and PP

PE and PP Plastic sewers may be joined either by heat fusion or with elastomeric seal joints. Consult the heat fusion joining portion of this *Handbook* for specifics on heat fusion joining.

Storm and Sanitary Sewers and Drains - Installation

All the model-plumbing codes include sections on installing sewer piping. Consult your local code and follow it. In the absence of local code provisions, use the following steps. Excavate to the desired grade. Be sure trench is safe — shore sides when in doubt. Use a transit or level line to obtain proper grade. Cut down high spots, fill holes or depressions, and tamp thoroughly. Remove all rocks or other sharp objects. If necessary in rough soil conditions, excavate to a greater depth than required and then backfill with select fill material to proper level and grade.

Where trenching conditions are difficult due to rock, water, gumbo soil, or other unstable conditions, the sewer pipe must be supported throughout its full length using treated timber, concrete pad, sand, or properly selected backfill material. Lay the pipe in a straight line. Use a level or transit to set the pipe to grade. Use proper fittings for all turns. Do not try to bend piping.

Be sure the pipe has full support. Encase the pipe in a protective "envelope" by filling along the sides with earth or fill free from large rocks. Tamp side fill material as it is placed. As with all underground installations, proper tamping will minimize deflection, is consistent with the pipe manufacturer's recommendations, and the plumbing codes.

Cover the entire pipe with clean earth or backfill to a depth of at least 12 inches, tamping along both sides but not over the pipe as you fill. The trench can now be filled either by hand or mechanically. All sewer pipe fittings should be of the drainage pattern. All materials, regardless of smoothness, are subject to stoppage. Cleaning rods, whether manual or automatic, will not execute sharp or short radius turns. Avoid future problems by providing full radius turns at every change in direction.

These are the fundamental requirements for every sewer or drain trench.

Molded plastic adapters and rubber ring doughnuts are available for connections during the tests. A water exfiltration test can be used making connections either size by size or one material to another. Do not use concrete cement or unauthorized joining material for making plastic pipe sewer joints. Use the proper connections only.

While drains are not generally considered the same as sewers, they also can encounter stoppage, flooding, and back flow due to poor installation. The same installation procedures should be followed when laying drains as when laying sewers.

Storm and Sanitary Sewers and Drains - Other Considerations

Storm and Sanitary Sewers and Drains - Testing

Where testing of the sewer service is required, it may be preferable to do it before covering the joints so that they can be checked for leaks. Soil can be placed over the pipe between the joints for protection during the tests. A water test is recommended. These piping systems shall not be tested with compressed air or other gases unless the procedure being used has been clearly and specifically approved by the manufacturer(s) of the plastic piping to be tested.

Note: By virtue of their compressibility, compressed air and gases contain large amounts of stored energy which present serious safety hazards should a piping system rupture for any reason.

Note: Ground water infiltration has become a major problem in sanitary sewer systems, because it overloads the sewer mains and the sewage treatment plant. In addition, leaking joints allow root penetration that can result in blockage. Ensure a watertight installation. Plastic piping joints – both solvent cemented and gasketed – are easy to make and remain watertight.