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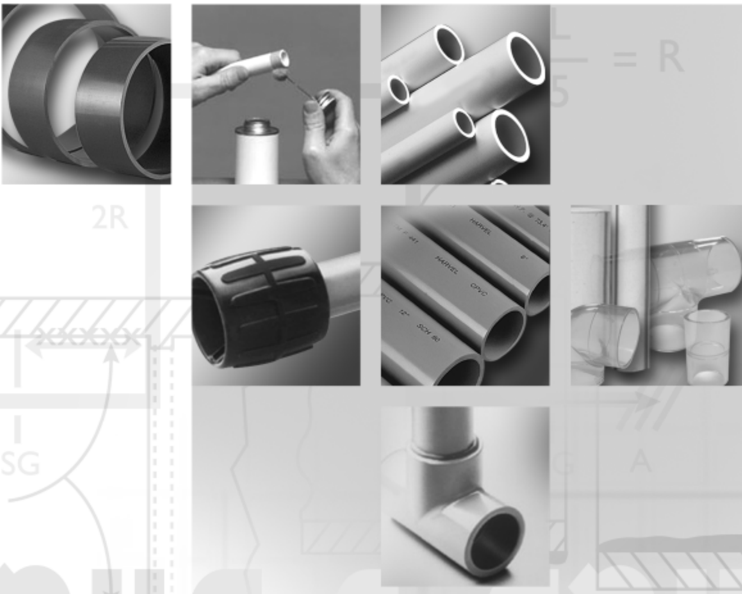
HARVEL®

PLASTICS, INC.



PVC and CPVC Pipe

Installation Guide

THE QUALITY LINE

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The following information is considered general in nature and is provided as a reference to assist in ensuring the highest system integrity during installation. Plastic piping systems must be designed, engineered, installed, and operated in accordance with accepted industry standards and practices, as well as any applicable code requirements. Suitability for the intended service must be clearly established prior to use. Proper selection, application, and installation of plastic piping products are the responsibility of the end user.

For additional detailed information, refer to Harvel Product Bulletin 112/401 or visit our website at www.harvel.com.

Storage & Handling

Harvel piping products are inspected, handled and loaded with great care at the factory using methods that have been developed specifically for plastic pipe to ensure that damage is minimized and overall quality is maintained during shipping. It is the carrier's responsibility to deliver the shipment in good condition. It is the receiver's responsibility to ensure that there has been no loss or damage, and that the products are unloaded and stored properly after receipt. Reasonable care and common sense should be used when handling and storing Harvel thermoplastic piping products.

Thermoplastic pipe and fittings may be stored indoors or outside in yards. If stored outdoors, pipe and fittings should be protected from direct exposure to sunlight, and pipe should be properly supported in storage to prevent sagging or bending. Pipe should be stored at the job site on level ground in the unit packages (skids) provided by the factory. Caution must be exercised to avoid compression, damage or deformation. When unit packages are stacked, care must be used to ensure that the weight of the upper units does not cause deformation to pipe in the lower units (i.e. stack palletized pipe wood on wood). Package units should not be stacked more than 8 feet high. Care must be used to ensure that the height of the stack does not result in instability, which can cause collapse, pipe damage or personnel injury. Unit packages should be supported by wooden racks or other suitable means, and spaced properly to prevent damage.

Thermoplastic pipe must not be stored in tightly enclosed areas subject to elevated temperatures or close to heat producing sources such as heaters, boilers, steam lines, engine exhaust, etc. Exposure to excessive temperatures will result in distortion and deformation of the product. When stored outdoors Harvel thermoplastic pipe must be covered with a non-transparent material. This covering must provide adequate air circulation above and around the pipe as required to prevent excessive heat absorption that can result in discoloration and deformation of the product. PVC piping products in storage should not be exposed to temperatures above 150˚F. CPVC piping products in storage should not be exposed to temperatures above 210˚F.

Although Harvel products are tough and corrosion resistant, they should not be dropped, have objects dropped on them, nor subjected to external loads. Thermoplastics can be damaged by abrasion and gouging. Pipe must not be dragged across the ground or over obstacles. Impacts such as dropping and/or rough handling should be avoided, particularly in cold weather. The product shall be inspected for any scratches, splits or gouges that may have occurred from improper handling or storage. If found, damaged sections must be cut out and discarded.

Plastic Piping Tools

Tools used with Plastic Piping

The use of tools that have been specifically designed for use with thermoplastic pipe and fittings is strongly recommended to obtain optimum results when installing thermoplastic piping systems. A variety of tools that are designed for cutting, beveling, and assembling plastic pipe and fittings are readily available through local wholesale supply houses dealing in plastic pipe and fittings.

Improper use of tools normally used with metal piping systems, i.e., hacksaws, water pump pliers, pipe wrenches, etc., can cause damage to plastic pipe and fittings. Visible and non-visible fractures, scoring or gouging of material, and over tightening of plastic threaded connections are some of the major problems associated with the use of incorrect tools and/or procedures.

Pipe Cutters

Plastic pipe must have square-cut ends to allow for the proper interfacing of the pipe end and the fitting socket bottom. A wheel type pipe cutter, with special blades for plastic pipe, provides easy and clean cutting action. The raised bead left on the outside of the pipe after cutting must then be removed. A miter box saw may also be used to produce square-cut ends.

Pipe Cutters for Large Diameter Pipe

Blade cutters made for use with large diameter plastic pipe are easy to adjust and operate for square, burr-less cuts. Blades with carbide edges will provide longer life. With one style blade cutter, pipe ends may also be beveled for solvent joints while being cut by using an optional bevel tool in place of one cutter blade.

Power Saws

Power saws especially for use with plastic pipe are available. These are particularly useful in prefabrication operations where a large quantity of pipe is being cut. Blades designed for thermoplastic pipe **MUST** be used. Follow manufacturer's instructions regarding speed, set and proper use of tool.

Pipe Beveling Tools

Portable and mounted power beveling tools, as well as hand beveling tools specifically designed for use with plastic pipe are available. Pipe ends must be beveled (chamfered) to allow easy insertion of the pipe into the fitting and to help prevent scraping the solvent cement from the inside of the fitting socket. A recommended bevel of 1/16" to 3/32" at a 10˚ to 15˚ angle can be quickly achieved using a plastic pipe beveling tool.

Deburring Tools

A smooth, beveled pipe end helps spread the solvent easily as the pipe is joined to the fitting. All burrs must be removed from the inside, as well as the outside, of the pipe ends. Special plastic pipe deburring tools debur pipe ends quickly and efficiently.

Strap Wrenches

Strap wrenches with special woven nylon straps are extra strong and are treated for slip resistance. These strap wrenches, designed for use with plastic pipe, provide gripping power for turning, without scratching or deforming the pipe.

Chain Vises

Chain vises are made with jaws for holding plastic pipe. Jaws engineered for use with plastic pipe provide holding power, without damage to the pipe.

Joining Devices

Pipe and fitting pullers are available designed specifically for joining large diameter plastic pipe and fittings. These tools are designed to allow the pipe to be inserted to the proper insertion depth, maintain proper alignment during assembly, and hold freshly solvent-cemented connections to prevent the fitting from backing-off until the initial set time is achieved. The use of these types of tools can also reduce assembly time.

Joining Techniques
Solvent Cementing

The solvent-cemented connection in thermoplastic pipe and fittings is the last vital link in a plastic pipe installation. It can mean the success or failure of the system as a whole. Accordingly, it requires the same professional care and attention that are given to other components of the system. There are many solvent cementing techniques published covering step by step procedures on just how to make solvent cemented joints. However, we feel that if the basic principles involved are explained, known and understood, a better understanding would be gained as to what techniques are necessary to suit particular applications, temperature conditions, and variations in size and fits of pipe and fittings.

Installers should verify for themselves that they can make satisfactory joints under varying conditions and should receive training in installation and safety procedures. Consult Harvel assembly instructions, Material Data Safety Sheet from the cement manufacturer, ASTM D2855 Standard Practice for Making Solvent cemented Joints with PVC Pipe and Fittings, and ASTM F402 Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings. **Follow appropriate cure times prior to pressure testing**—refer to Cure Schedules and Testing sections.

Safety Precautions

Solvent cement products are flammable and contain chemical solvents, therefore appropriate safety precautions should be taken. Read the cement can label!

Be aware at all times of good safety practices. Solvent cements for pipe and fittings are flammable, so there should be no smoking or other sources of heat or flame in working or storage areas. Be sure to work only in a well-ventilated space and avoid unnecessary skin contact with all solvents. More detailed safety information is available from the solvent cement manufacturer.

⚠ CAUTION BEFORE APPLYING PRIMER AND CEMENT, appropriate safety precautions should be taken.

Virtually all solvent cements and primers for plastic pipe are flammable and should not be used or stored near heat, spark or open flames. Do not smoke during use. Eliminate all ignition sources. Primer and cement should be stored in closed containers in the shade at temperatures between 40˚F and 110˚F.

Avoid breathing vapors. *They should be used only with adequate ventilation. Explosion-proof general mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below recommended exposure limits. In confined or partially enclosed areas, a ventilating device should be used to remove vapors and minimize their inhalation. A NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. Commercially available respirators especially designed to minimize the inhalation of organic vapors can also be used. Containers should be kept tightly closed when not in use, and covered as much as possible when in use.*

Avoid frequent contact with skin and eyes. *May be absorbed through the skin; wearing PVA coated protective gloves and an impervious apron are recommended. May cause eye injury. Avoid any contact with eyes; splash proof chemical goggles are recommended. In case of contact flush with plenty of water for 15 minutes. If irritation persists, get medical attention. If swallowed, call a physician immediately and follow precautionary statement given on side panel of cement container. Keep out of reach of children.*

Containers should be kept tightly closed when not in use and covered as much as possible when in use. Use of an applicator can with applicator attached to a lid is especially recommended. ***Verify expiration dates stamped on cements and primers prior to use.***

REFER TO SOLVENT CEMENT MANUFACTURERS MATERIAL SAFETY DATA SHEETS (MSDS) PRIOR TO USE

⚠ WARNING Use Caution with Welding Torches

At construction sites where plastic pipe is being installed or has recently been solvent welded, special caution should be taken when using welding torches or other equipment where sparks might be involved. Flammable vapors from cemented joints sometimes linger within or around a piping system for some time. Special care must be taken when using a welding torch in these applications:

- Well casing installations
- Elevator shafts or similar applications where fumes could accumulate
- Installing pumps
- Installation of plastic pipe systems in industrial plants

In all cases, lines should be purged to remove solvent vapors before welding.

⚠ WARNING **Use Caution with Calcium Hypochlorite**
Do not use a dry granular calcium hypochlorite as a disinfecting material for water purification in potable water piping systems. The introduction of granules or pellets of calcium hypochlorite with solvent cements and primers (including their vapors) may result in violent chemical reactions if a water solution is not used. It is advisable to purify lines by pumping chlorinated water into the piping system—this solution will be nonvolatile.

Furthermore, dry granular calcium hypochlorite should not be stored or used near solvent cements or primers.

Actually, solvent cementing is no more dangerous than putting gasoline in your automobile.

Solvent Cement and Primer Spills
Work areas should be protected by using drop cloths in the event of an accidental spill. Cement and/or primer spills can cause irreparable damage depending on the type of surface affected. Accidental spills should be wiped up immediately before the cement sets. A mild soap and water mixture may aid in removal of a stain; however, the use of solvents or harsh cleansers may do more damage than good. In the event of a spill, consult the manufacturer of the affected surface for possible suggestions. Protecting the work area prior to starting is recommended.

People have learned they must be careful with gasoline. Although solvent cements are not as flammable as gasoline, users must also learn to be careful. Again, accidents and injuries have seldom occurred in the use of these products. Help maintain and improve this excellent record by following the above recommendations.

Applicators

A wide variety of daubers, brushes, and rollers are available from the solvent cement manufacturer. Use the appropriate type and size applicator for the materials being joined. It is important to use a proper size applicator. A dauber, brush, or roller approximately one-half the size of the pipe diameter being joined is appropriate. Do not use daubers attached to the cement can lid on large diameter products (> 3" dia.) as sufficient cement cannot be applied. Generally daubers supplied on pint can lids are suitable for pipe sizes 1/2" – 1-1/4" diameters, and daubers supplied on quart can lids are suitable with pipe sizes from 1-1/2" – 3" diameters. Rollers are available for pipe sizes greater than 3".

Primers

The use of Primer is necessary to penetrate and dissolve the surface of the pipe and fitting prior to the application of cement. This is particularly true when working with large diameter pipe and conventional Schedule 40 and Schedule 80 piping for use in pressure applications. Primer must be applied to both the pipe and fittings. Apply primer to the fitting socket, then to the outside of the pipe end, than a second coat to the fitting socket; re-dipping the applicator as necessary to ensure entire surface is wet.

! NOTE Solvent cement should be applied immediately after primer while the surfaces are still tacky.

Solvent Cements

Select the appropriate solvent cement and primer for the type of products being joined.

The cement system used for joining PVC and CPVC plastic pipe is a solvent-based type. The solvent, typically tetra hydro furan (THF), dissolves the mating surfaces when properly applied to each surface. The PVC or CPVC resin filler contained in the cement assists in filling the gaps between pipe and fitting surfaces. An evaporation retardant, usually cyclohexanone, slows the rate of evaporation of the prime solvent (THF). Some cements are available clear, while most others contain pigments to match the pipe color. The most common color is gray, made from titanium dioxide and carbon black, which are considered inert pigments. Joining of the wet mating surfaces in one minute or less after starting to cement is essential to eliminate dry spots that will not bond. The bond interface will consist of a mixture of cement resin and dissolved PVC or CPVC from the attached pipe and fitting surfaces. As the solvent evaporates, the interface becomes homogeneous with the pipe and fitting surfaces except for residual solvent, which dissipates over a period of time. The resultant homogeneous bonded area has led to the term "solvent welded" although no heat is applied to melt and fuse the bonded areas as in metal welding.

A wide variety of different grades of solvent cements are available for different applications, pipe sizes and material types. They are usually classified as light or regular bodied, medium bodied, heavy bodied, extra heavy bodied and specialty cements. Different types of cements have different set and cure times.

1. **Light/Regular Bodied –** Cements for smaller diameters (i.e. < 4") and thin-wall classes and Schedule 40 piping with interference fits. They typically are called Schedule 40, quick-dry, regular body cement, or light-body cement. These cements are not designed to fill as much of a gap, tend to dry faster, do not bite into the pipe and fitting as much, and cure somewhat faster.

2. **Medium Bodied –** Cements for smaller diameters (i.e. < 4") for all classes, Schedule 40 and Schedule 80 pipe with interference fits. These cements have slightly better gap filler properties than regular bodied cement but are still considered fast setting cements.

3. **Heavy Bodied & Extra Heavy Bodied –** Cements for large diameters, and heavier-wall Schedule 80 and 120 products where the pipe is not as roundable. These cements are called heavy-weight, heavy-body, or Schedule 80 cements, and are designed to fill larger gaps, dry slower, bite into the pipe and fitting more, and have longer cure times.

4. **Specialty Cements -** Specialty cements have been formulated, developed, and tested for use with specific products and applications. Examples include Low VOC cements, transition cements, product specific, and one-step cements. One-step cements do not require the use of primer prior to the application of the cement, however their use is somewhat limited. Examples include one-step cements for use with CPVC fire sprinkler piping, CPVC hot and cold water plumbing pipe, and clean PVC cements for use in high purity applications (i.e. Harvel LXT®). Another example is specialty cements developed with improved chemical resistance to caustics. Specialty cements must be used in strict accordance with the manufacturers instructions for the intended application and should not be used to join conventional PVC/CPVC piping without investigating their suitability for use.

Contact Harvel or the solvent cement manufacturer for proper selection of primers, solvent cements, and applicators for various applications. Review the solvent cement manufacturers assembly instructions. Product training free of charge is available.

Basic Principles of Solvent Cementing

The solvent-cemented connection in thermoplastic pipe and fittings is the last vital link in a plastic pipe installation. It can mean the success or failure of the system as a whole. Accordingly, it requires the same professional care and attention that are given to other components of the system. There are many solvent cementing techniques published covering step-by-step procedures on just how to make solvent cemented joints. However, we feel that if the basic principles involved are explained, known and understood, a better understanding would be gained as to what techniques are necessary to suit particular applications, temperature conditions, and variations in size and fits of pipe and fittings.

Be aware at all times of good safety practices. Solvent cements for pipe and fittings are flammable, so there should be no smoking or other sources of heat or flame in working or storage areas. Be sure to work only in a well-ventilated space and avoid unnecessary skin contact with all solvents. Refer to Safety Precautions section for additional information.

To consistently make good joints, the following should be carefully understood:

1. The joining surfaces must be softened and made semi-fluid.

2. Sufficient cement must be applied to fill the gap between pipe and fitting.

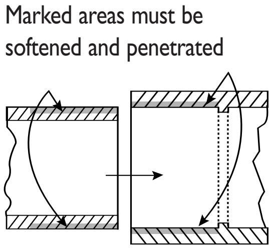
3. Assembly of pipe and fittings must be made while the surfaces are still wet and fluid.

4. Joint strength develops as the cement dries. In the tight part of the joint the surfaces will tend to fuse together, in the loose part the cement will bond to both surfaces.

Important: Installers should verify for themselves that they can make satisfactory joints under varying conditions and should receive training in installation and safety procedures.

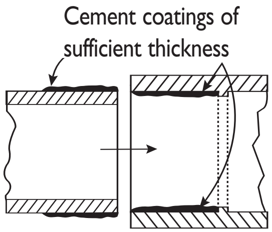
Softening and Penetration

These areas must be softened and penetrated. This can be achieved by the cement itself, by using a suitable primer, or by the use of both primer and cement. A suitable primer will usually penetrate and soften the surfaces more quickly than the cement alone.

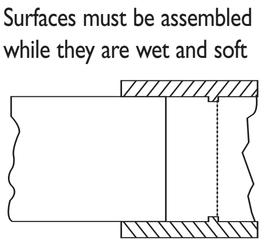


Sufficient Application of Cement

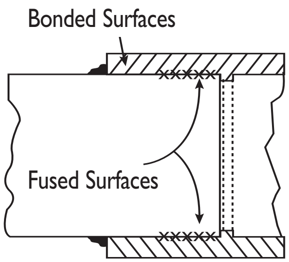
More than sufficient cement to fill the gap in the loose part of the joint must be applied. In addition to filling the gap, adequate cement layers will penetrate the joining surfaces and remain fluid until the joint is assembled.



If the cement coatings on the pipe and fittings are wet and fluid when assembly takes place, they will tend to flow together and become one layer. Also, if the cement is wet, the surfaces beneath them will still be soft, and these softened surfaces in the tight part of the joint will tend to fuse together.



As the solvent dissipates, the cement layer and the softened surfaces will harden with a corresponding increase in joint strength. A good joint will take the required working pressure long before the joint is fully dry and final strength is obtained. In the tight (fused) part of the joint, strength will develop more quickly than in the looser (bonded) part of the joint. Information about the development of bond strength of solvent cemented joints is available.



Hot Weather

There are many occasions when solvent cementing Harvel piping products in 95˚F temperatures and over cannot be avoided. If a few special precautions are taken, problems can be avoided. Solvent cements contain high-strength solvents which evaporate faster at elevated temperatures. This is especially true when there is a hot wind blowing. If the pipe has been in direct sunlight for any length of time, surface temperatures may be 20˚F to 30˚F above air temperature. Solvents attack these hot surfaces faster and deeper, especially inside a joint. Thus, it is very important to avoid puddling inside sockets, and to wipe off excess cement outside.

Tips to Follow when Solvent Cementing in High Temperatures:

1. Store solvent cements in a cool or shaded area prior to use.
2. If possible, store the fittings and pipe, or at least the ends to be solvent welded, in a shady area before cementing.
3. Cool surfaces to be joined by wiping with a damp rag. Be sure that surfaces are dry prior to applying solvent cement.
4. Try to do the solvent cementing in cooler morning hours.
5. Make sure that both surfaces to be joined are still wet with cement when putting them together.

Cold Weather

Solvent Cement products have excellent cold weather stability and are formulated to have well balanced drying characteristics even in subfreezing temperatures. Good solvent cemented joints can be made in very cold conditions provided proper care and a little common sense are used. In cold weather, solvents penetrate and soften surfaces more slowly than in warm weather. The plastic is also more resistant to solvent attack, therefore, it becomes more important to pre-soften surfaces. Because of slower evaporation, a longer cure time is necessary.

Tips to Follow when Solvent Cementing in Low Temperatures:

1. Prefabricate as much of the system as possible in a heated work area.
2. Store cements in a warmer area when not in use and make sure they remain fluid.
3. Take special care to remove moisture, including ice and snow.
4. Use special care to ensure joining surfaces are adequately softened; more than one application may be necessary.
5. Allow a longer cure period before the system is used.

Follow appropriate set and cure times prior to pressure testing.

Getting Started

- Review Safety Precautions
- Review Cement Can Label
- Review Assembly Instructions
- Condition pipe and fittings being joined to the same temperature conditions prior to use

Inspection Before Use

Pipe and fittings should always be inspected for damage before actual installation. Pipe or pipe fittings with cuts, gouges, scratches, splits, or other signs of damage from improper handling or storage should not be used. Damaged sections on lengths of pipe can easily be cut out using proper techniques for cutting thermoplastic pipe.

Check Material

Make sure the fittings, valves, and pipe being joined are of the same type of plastic product (i.e. PVC or CPVC). It is unwise to use Type I and Type II PVC, for example, in the same installation. The expansion and contraction features, pressures, etc., are vastly different, and use of mixed materials could cause failure. It is also recommended that the fittings and pipe should be of the same schedule. It is not recommended that Schedule 40 fittings, for example, be used with Schedule 80 pipe, since the pressure rating, socket depth, and other features may not lend themselves to a Schedule 80 installation. Make sure that the proper primer and cement is being used with the proper pipe and fittings. Never use CPVC cement on Type I PVC pipe or, conversely, never use PVC cement on CPVC pipe and fittings. Verify the expiration dates stamped on the cements and primers prior to use (date codes can typically be found on the bottom of the container).

Handling of Cement

Keep cement containers covered while not in use. If the container of cement with the lid off is subjected to prolonged exposure to air, the cement in the can becomes thick and viscous, or gel like. Chances are that this condition has been brought about by the evaporation of the tetra hydro furan (THF) solvent. If this occurred, the cement is useless. Do not try to restore the cement by stirring in a thinner. For this reason, it is suggested that smaller containers of cement, rather than the large container, be used, especially in warm or hot weather. Prior to using an unopened can of cement, it is well to shake it vigorously to insure proper dispersion of the resin and solvents. Keep in mind that the solvents contained in PVC cements are highly flammable and should not be used near an open flame. The area in which the cement is being used should be well ventilated, and prolonged breathing of the fumes should be avoided, as well as contact with the skin or eyes. All PVC cement should be handled in the same manner as a very fast-drying lacquer. Verify the expiration dates stamped on the cements and primers prior to use.

Estimated Quantities of Solvent Cement

Estimated quantities of Harvel PVC and CPVC cement can vary due to installation conditions, tolerance variations, and socket depths. Fabricated and belled fittings will usually require larger quantities. It is better practice to error on the liberal side than skimp if precautions as outlined in Harvel's instructions are recognized and followed. Field conditions or a combination of factors could occur during installation that has not yet been encountered. Consequently, the information contained herein may be considered as a basis for recommendation but not as a guarantee.

Fabricated fittings socket depths can vary with respect to manufacturer or if the fitting is pressure rated. The cement requirements shown for these sizes are based upon the socket depths shown. If the socket depth is shorter, a smaller quantity of cement can be utilized. For example, if the socket depth of a 12" fitting is only 5", you would take 5/8.5 of the cement quantity shown per joint. If the socket depth is 9" for a 12" fitting, you would take 9/8.5 of the cement quantity shown.

Quantities of P-70 Primer requirements average 1/3 of the cement requirements.

Estimated Number of Joints per Pint Based on Pipe Diameter

Size Fitting (in.)	No. of Joints	No. of Couplings or 90s	No. of Tees	No. of Belled Pipe Joints
1/2	190	95	64	N/A
3/4	120	60	40	N/A
1	100	50	33	N/A
1-1/4	70	35	24	N/A
1-1/2	50	25	17	N/A
2	30	15	10	25
2-1/2	25	12	8	20
3	20	10	6	16
4	12	6	4	9
5	9	4.5	3	-
6	5	2.5	1.7	3
8	2.5	1	.8	2

Estimated Number of Joints per Quart Based on Pipe Diameter

Size Fitting (in.)	No. of Joints	No. of Couplings or 90s	No. of Tees	No. of Belled Pipe Joints
1/2	380	190	127	N/A
3/4	240	120	80	N/A
1	200	100	66	N/A
1-1/4	140	70	48	N/A
1-1/2	100	50	33	N/A
2	60	30	20	50
2-1/2	50	24	16	40
3	40	20	12	32
4	24	12	8	18
5	18	9	6	-
6	10	5	3.3	6
8	5	2.1	1.6	4

Socket Joints

Size (in.)	Socket Depth (in.)	Cement* Quarts/Joint
10	8	.75
12	8-1/2	1.00
14	9	1.25
16	10	1.50
18	12	2.00
20	12	2.25
24	14	3.25

! NOTE Harvel recommends Weld-On 717 for all schedules and SDR's 1/8" - 5", and Weld-On 719 for all schedules and SDR's 6" - 24". Weld-On 717, 719 are registered trademarks of IPS Corporation.

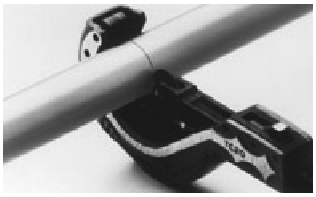
Assembly Instructions

⚠CAUTION **BEFORE APPLYING PRIMER AND CEMENT,** appropriate safety precautions should be taken. Primer and cement should be stored in the shade between 40°F and 110°F. Eliminate all ignition sources. Avoid breathing vapors. Use only with adequate ventilation; explosion-proof general mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below recommended exposure limits. In confined or partially enclosed areas, a NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. Containers should be kept tightly closed when not in use, and covered as much as possible when in use. Avoid frequent contact with skin; wearing PVA-coated protective gloves and an impervious apron are recommended. Avoid any contact with eyes; splash proof chemical goggles are recommended. (Please refer to Safety, Basic Principles, and Getting Started sections on the preceeding pages prior to use). Verify expiration dates stamped on cements and primers prior to use.

Component Preparation: Condition the pipe and fittings to the same temperature conditions prior to use. All pipe, fittings and tools used for joining must be clean and free of dirt, moisture, grease or other contamination prior to and during the joining process.

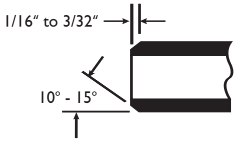
1. Cutting

Cut ends of pipe square using appropriate tools. To ensure the pipe is cut square, a miter box must be used when using a saw. Cutting the pipe as squarely as possible provides the surface of the pipe with a maximum bonding area. Harvel PVC and CPVC pipe can be easily cut with a wheel-type plastic tubing cutter, a power saw, or a fine toothed saw. Care must be taken not to split the pipe if a ratchet type cutter is used, especially in temperatures below 50°F. If any indication of damage or cracking is evident, cut off at least two (2) inches beyond any visible crack. It is important that the cutting tools used are designed for use on plastic pipe; refer to plastic piping tools section.



2. Bevel/Debur

Burrs and filings can prevent contact between pipe and fitting during assembly, and must be removed from the outside and the inside of the pipe. A chamfering tool or file is suitable for this purpose. A slight bevel shall be placed at the end of the pipe to ease entry of the pipe into the socket and minimize the chances of wiping solvent cement from the fitting. Place a 10° to 15° bevel approximately 1/16" to 3/32" in width on the end of the pipe.



3. Joining Preparation

A. Inspect & Clean Components - Prior to assembly, all components shall be inspected for any damage or irregularities Mating components shall be checked to assure that tolerances and engagements are compatible. Do not use components that appear irregular or do not fit properly. Contact the appropriate manufacturer of the component product in question to determine usability. Using a clean, dry rag, wipe loose dirt and moisture from the fitting socket and pipe end. Moisture can slow the cure time, and at this stage of assembly, excessive water can reduce joint strength.

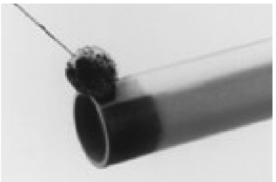
B. Check the dry fit - The pipe should enter the fitting socket easily one-quarter to three-quarters of the way. If the pipe bottoms in the fitting with little interference, use extra solvent cement in making the joint. If the pipe bottoms in the fitting with little interference, use extra solvent cement in making the joint.

C. Measure the socket depth - Measure the socket depth of the fitting and mark this distance on the pipe end. This reference mark can be used when joining to ensure the pipe is completely bottomed into the fitting during assembly.

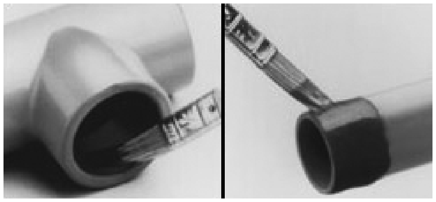
D. Position the pipe and fitting for alignment.

4. Primer Application

Primer must be used to prepare the bonding area for the addition of the solvent cement and subsequent assembly. It is important to use a proper applicator—a dauber, natural bristle brush, or roller approximately 1/2 the size of the pipe diameter is appropriate. A rag must NOT be used. Primer must be applied to both the pipe and fittings. Apply Primer to the fitting socket, then to the outside of the pipe end, then a second coating to the fittings socket, re-dipping applicator as necessary to ensure entire surface is wet. Repeated applications may be necessary.



5. Solvent Cement Application



The solvent cement shall be applied when the pipe and fittings are clean and free of any moisture and debris, and must be applied immediately while primer is still tacky. Cement shall be applied to the joining surfaces using a dauber, natural bristle brush, or roller approximately 1/2 the size of the pipe diameter. Apply a heavy, even coat of cement to the outside pipe end to equal to the depth of the fitting socket. The amount should be more than sufficient to fill any gap. Apply a medium coat to the fitting socket. Avoid puddling. If there was little or no interference when the dry fit was checked, a second application of cement should be made to the pipe end.

6. Assembly

While BOTH SURFACES are STILL WET with solvent cement, immediately insert the pipe into the fitting socket while rotating the pipe 1/4 turn. Pipe must bottom completely to the fitting stop. Properly align the fitting for installation at this time. Hold the assembly for approximately 30 seconds to ensure initial bonding. Due to the taper on the interference fit, the pipe can back-off the fitting stop if steady pressure is not held on the joint during initial bonding. A bead of cement should be evident around the pipe and fitting juncture. If this bead is not continuous around the socket shoulder, it may indicate that insufficient cement was applied. If insufficient cement is applied, the joint must be cut out, discarded and begun again. Cement in excess of the bead can be wiped of with a rag.

7. Set and Cure Times

Solvent Cement set and cure times are a function of: the cement type used, pipe size, temperature, relative humidity, and tightness of fit. Drying time is faster for drier environments, smaller pipe sizes, high temperatures and tighter fits. The assembly must be allowed to set, without any stress on the joint, for 1 to 5 minutes depending on the pipe size and temperature. Following the initial set period the assembly can be handled carefully avoiding stresses to the joint. **All solvent-cemented assemblies must be allowed to cure properly prior to pressure testing.** Refer to solvent cement manufacturers set and cure schedule prior to testing, and Harvel's suggested set and cure time, detailed solvent cementing information, and testing section for additional information.

! NOTE The general step by step instructions provided herein are based on the use of conventional Schedule 40 & Schedule 80 PVC & CPVC industrial piping products used under normal installation conditions and cannot be construed as covering every possible combination of field conditions. Specialty piping systems such as Harvel CPVC fire sprinkler piping products, Harvel LXT® UPW piping products, and other products have specific solvent cementing instructions that may vary from above. Follow appropriate solvent cementing procedures for the products being utilized.

Set and Cure Times

! NOTE The following set and cure times are average times based on the use of IPS Weld-On P-70 Primer and IPS Weld-On #717 and/or IPS Weld-On #719 Solvent cements as applicable for joining Schedule 40 & Schedule 80 PVC Piping, and the use of IPS Weld-On #714 as applicable for joining Schedule 40 & Schedule 80 CPVC Piping. Actual set and cure times are dependent on the pipe material and solvent cement system utilized, pipe size, temperature, relative humidity, pressure and tightness of fit.

SET TIME: The initial set times shown below are the recommended waiting periods before handling newly assembled joints. After initial set, the joints will withstand the stresses of normal installation. (A badly misaligned installation will cause excessive stresses in the joint, pipe and fittings.)

Average Set Times

Temp. Range	Pipe Sizes 1/2" – 1-1/4"	Pipe Sizes 1-1/2" – 2"	Pipe Sizes 2-1/2" – 8"	Pipe Sizes 10" – 15"	Pipe Sizes 16" – 24"
60°- 100°F	2 Min.	5 Min.	30 Min.	2 Hrs.	4 Hrs.
40°- 60°F	5 Min.	10 Min.	2 Hrs.	8 Hrs.	16 Hrs.
0°- 40°F	10 Min.	15 Min.	12 Hrs.	24 Hrs.	48 Hrs.

CURE TIME: The cure time is the recommended waiting period before pressurizing newly assembled joints. These times depend on type of cement used, pipe size, fit, temperature, humidity and pressure. Follow appropriate cure times carefully. Allow longer cure periods for high humidity and/or cold weather - consult solvent cement manufacturer.

Avoid puddling of cement or primer on or within fitting and pipe that causes excess softening of the material and could cause damage to the product.

Average Cure Times

Relative Humidity 60% or Less*	Pipe Sizes 1/2" – 1-1/4"		Pipe Sizes 1-1/2" – 2"	
Temperature Range During Assembly and Cure Periods	Up to 160 psi	Above 160 to 370 psi	Up to 160 psi	Above 160 to 315 psi
60° - 100° F	15 Min.	6 Hrs.	30 Min.	12 Hrs.
40° - 60° F	20 Min.	12 Hrs.	45 Min.	24 Hrs.
0° - 40°F	30 Min.	48 Hrs.	1 Hr.	96 Hrs.

Relative Humidity 60% or Less*	Pipe Sizes 2-1/2" – 8"		Pipe Sizes 10" – 15"	Pipe Sizes 16" – 24"
Temperature Range During Assembly and Cure Periods	Up to 160 psi	Above 160 to 315 psi	Up to 100 psi	Up to 100 psi
60° - 100° F	1-1/2 Hrs.	24 Hrs.	48 Hrs.	72 Hrs
40° - 60° F.	4 Hrs.	48 Hrs.	96 Hrs.	6 Days
0° - 40°F	72 Hrs.	8 Days	8 days	14 Days

! NOTE In damp or humid weather allow 50%, more cure time. The cure schedules shown are provided as a courtesy and are suggested as guides only. They are based on laboratory test data, and should not be taken to be the recommendations of all cement manufacturers. Individual solvent cement manufacturer's recommendations for the particular cement being used should be followed. The above cure schedules are based on laboratory test data obtained on Net Fit Joints (NET FIT = in a dry fit, the pipe bottoms snugly in the fitting socket without meeting interference). Contact the appropriate solvent cement manufacturer for additional information.Important Installers should verify for themselves that they can make satisfactory joints under varying conditions and should receive training in installation and safety procedures.

Large Diameter Pipe

The basic solvent cement instructions apply to all sizes of pipe, but when making joints 4" and above, the use of two men to apply the solvent cement simultaneously to pipe and fitting is recommended. Additional men should also be in a position to help “push” the pipe into the fitting socket while the cemented surfaces are still wet and ready for insertion. Alignment of large diameter pipe and fittings is much more critical than when working with small diameter pipe. Specialty large diameter joining tools developed specifically for joining large diameter PVC and CPVC piping products are available.

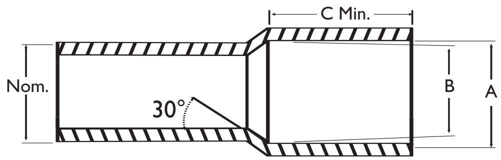
It is imperative to use the appropriate size applicator for the application of primer and cement when working with large diameter pipe. Use a roller approximately one-half the size of the diameter of pipe being joined. As the pipe diameters increase, the range of tolerances also increases, which can result in “out of round” and “gap” conditions. Speed in making the joint and applications of heavy coats of solvent cement in these cases is important. When working with pipe diameters such as 8" through 24", checking the dry fit of pipe and fittings again is more critical on these large sizes. In many cases where fabricated fittings are used, interference fits may not be present, and consequently it will be necessary to apply more than one coat of cement to the pipe and fitting. It is essential to use a heavy bodied, and/or extra heavy-bodied, slow drying cement on these large diameter sizes.

IPS Weld On 719 is a gray, extra heavy bodied, thixotropic (paste like), high strength PVC Solvent Cement. It provides thicker layers and has a higher gap filling property than regular heavyweight cement. It also allows slightly more open time before assembly. It is formulated for joining large size PVC pipe and fittings in all schedules and classes, including Schedule 80. It has excellent gap filling properties, which are particularly desirable where a sizeable gap exists between pipe and fitting. Under a damp or wet condi-tion, this cement may absorb some moisture. Excessive moisture tends to slow down the cure and can reduce the ultimate bond strength. Contact Harvel or the solvent cement manufacturer for the proper selection of solvent cements when working with large diameter products.

Belled End Pipe

In many installations, belled end pipe can be used to eliminate the need for couplings. Where belled end pipe is used, it is suggested that the interior surface of the bell be penetrated exceptionally well with the primer.

Harvel does not use silicone lubricants in the belling process. However, some manufacturers use a silicone release agent on the belling plug, and a residue of this agent can remain inside the bell. This residue must be removed in the cleaning process prior to solvent cementing.



Harvel Belled-End Pipe Dimensions

Nominal Size (in.)	A Min.	A Max	B Min.	B Max	C Min.
1-1/4	1.675	1.680	1.648	1.658	1.870
1-1/2	1.905	1.914	1.880	1.888	2.000
2	2.381	2.393	2.363	2.375	2.250
2-1/2	2.882	2.896	2.861	2.875	2.500
3	3.508	3.524	3.484	3.500	3.250
4	4.509	4.527	4.482	4.500	4.000
5	5.573	5.593	5.543	5.563	4.000
6	6.636	6.658	6.603	6.625	6.000
8	8.640	8.670	8.595	8.625	6.000
10	10.761	10.791	10.722	10.752	8.000
12	12.763	12.793	12.721	12.751	8.500
14	14.030	14.045	13.985	14.000	9.000
16	16.037	16.052	15.985	16.000	10.000
18	18.041	18.056	17.985	18.000	12.000
20	20.045	20.060	19.985	20.000	12.000
24	24.060	24.075	24.000	24.015	14.000

Threaded Connections

Harvel Plastics, Inc. recommends the use of a quality Teflon® tape having a thickness of 0.0025” or greater that meets or exceeds military specification MIL-T-27730A for making-up threaded connections. Not more than 3 to 3-1/2 mil thickness is recommended.

! NOTE Some oil base pipe joint compounds and/or Teflon® pastes contain ingredients that attack PVC or CPVC piping products. Assurances should be obtained from the manufacturer of the thread sealants that long-term tests with either material (PVC and/or CPVC) show no deleterious effects. Special examination should be made for environmental stress cracking. Suitability of thread paste compounds for use with plastics must be clearly established prior to use.

Assembly of Threaded Joints

Starting with the first full thread and continuing over the entire thread length, making sure that all threads are covered, wrap Teflon® tape in the direction of the threads. The tape should be started in a clockwise direction at the first or second full thread with a half width overlap over the effective thread length. It should be wrapped with enough tension so threads show through the single wrap area. Generally 2 to 3 wraps of tape are sufficient. Pipe sizes 2" and larger will benefit with not more than a second wrap due to the greater depth of thread.

Care must be used to avoid overtorquing during assembly. Generally 1 to 2 turns beyond finger tight is all that is required to obtain a leak-tight seal for most pipe sizes. Harvel recommends the use of a strap wrench when making up threaded connections as pipe wrenches, pliers and similar tools can cause damage to plastic pipe and fittings. Factory testing has indicated that 10–25 ft.-lbs. of torque is typically adequate to obtain a leak free seal. Sharp blows, dropping or straining of any kind should be avoided. The thread should not be forced. The larger sizes will usually not make up as much by hand and will require more wrench make up.

! NOTE Use of threaded pipe requires a 50% reduction in pressure rating stated for plain end pipe @ 73°F. Harvel Plastics, Inc. does not recommend the use of PVC for threaded connections at temperatures above 110°F (>150°F for CPVC). Use specialty reinforced female adapters, flanges, socket unions, or grooved couplings where disassembly may be necessary on PVC or CPVC systems operating at elevated temperatures.

Plastic To Metal Threaded Joints

The American Standard Taper pipe thread was designed for metal pipe with appreciably higher tensile strengths than plastic. Occasionally it may be necessary to make a metal to plastic threaded joint. A male plastic thread can be inserted into a female metal thread if heat is not involved and both lines are anchored immediately adjacent to the joint. Male metal threads should not be connected to a female plastic pipe thread unless specialty reinforced plastic female adapters are used. Refer to “Specialty Adapters” section for additional information.

Flanged Connections

Flanged joints can be used in applications where frequent dismantling is required. PVC and CPVC flanges are available in socket, spigot and threaded configurations in a variety of styles including one piece solid style flanges and two piece Van Stone style flanges where the bolt ring spins freely of the hub, easing bolt hole alignment during assembly. Most plastic flanges carry a maximum working pressure rating of 150 psi non-shock for water at 73˚F. Care should be taken to select the proper gasket material for compatibility with the fluid being conveyed.

Flange bolts should be tight enough to compress the gasket slightly and make a good seal, but not so tight as to distort the flange. Suitable washers should be used between the bolt head and nut. Opposite bolts should be made up in alternate sequence. Follow flange manufacturers assembly instructions, recommended bolt torque values, and bolt tightening sequence.

Recommended Flange Bolt Torque for Plastic Flanges

Flange Size (in.)	No. of Bolt Holes	Bolt Dia. (in.)	Min. Bolt Length (in.)	Torque ft.-lb. PSI
1/2	4	1/2	2	10-15
3/4	4	1/2	2	10-15
1	4	1/2	2-1/4	10-15
1-1/4	4	1/2	2-1/4	10-15
1-1/2	4	1/2	2-1/2	20-30
2	4	5/8	3	20-30
2-1/2	4	5/8	3-1/4	20-30
3	4	5/8	3-1/4	20-30
4	8	5/8	3-1/2	20-30
6	8	3/4	4	30-50
8	8	3/4	4-1/2	30-50
10	12	7/8	5	50-80
12	12	7/8	5	80-100
14	12	1	5-1/2	100-120
16	16	1	6-1/2	100-120
18	16	1-1/8	4-1/8	100-120
20	20	1-1/8	5-1/2	100-120
24	20	1-1/4	5-1/2	100-120

Bolt Torque

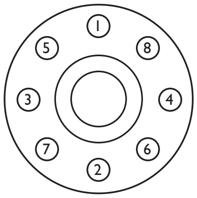
Recommended bolt torque is shown above. Threads should be cleaned and well lubricated. Actual field conditions may require variations in these recommendations.

⚠ CAUTION UNNECESSARY OVER TORQUING WILL DAMAGE THE FLANGE.

Gaskets

Full faced, 1/8" thick elastomer gaskets with a Shore "A" Durometer of approximately 70 is recommended.

Flange Bolt Tightening Sequence



Flange Make-up

Follow proper solvent cementing and/or threaded component procedures as applicable to join the flange to the pipe. Once a flange is joined to pipe, the method for joining two flanges is as follows:

A. Piping runs joined to the flanges must be installed in a straight-line position to the flange to avoid stress at the flange due to misalignment. Piping must also be secured and supported to prevent lateral movement that can create stress and damage the flange.

B. With gasket in place, align the bolt holes of the mating flanges by rotating the ring into position.

C. Insert all bolts, washers (two standard flat washers per bolt), and nuts.

D. Make sure the faces of the mating surfaces are flush against the gasket prior to bolting down the flanges.

E. Tighten the nuts by hand until they are snug. Establish uniform pressure over the flange face by tightening the bolts in 5 ft.-lbs. increments according to the sequence shown in the diagram, following a 180° opposing sequence.

F. Care must be taken to avoid "bending" the flange when joining a flange to a "raised face" flange, or a wafer-style valve. Do not use bolts to bring together improperly mated flanges.

Specified minimum bolt lengths are based on the use of two flanges manufactured by Spears, two standard flat washers, standard nut and 1/8" thick elastomer full-face gasket. Mating with other brands or accessories may require variation. Bolts and gaskets are not supplied with flanges.

Actual field conditions may require a variation in these recommendations.

The above recommendations are considered general and are provided as a courtesy. Follow flange component manufacturers assembly instructions to ensure the highest system integrity.

Groove Style Connections

In many installations where transition to metal pipe, or where disassembly is a prime factor, metallic grooved style couplings can be used to join PVC and CPVC pipe to alternate IPS size piping materials. In addition to the ease of disassembly, this type of connection also allows for a certain degree of angular adjustment and expansion/contraction. In order to prepare the plastic pipe for adapting the grooved style couplings, it is necessary to roll a groove onto each end of the pipe without sacrificing the wall thickness. Where shock loads from intermittent operation are probable, particularly with large diameter pipe, angular displacement should be avoided and the pipe aligned longitudinally to minimize high stress levels on the grooves. Grooved end pipe is available from Harvel; contact the factory for information.

In addition to roll grooving pipe, injection molded PVC and CPVC grooved coupling adapters are also available for joining plastic pipe to metal pipe via the use of the grooved style couplings.

Only flexible style metallic grooved couplings are recommended for use with plastic pipe. Rigid style couplings can provide a compressive/shear load to plastic pipe resulting in failure; as a result their use is not recommended. Care should be taken to investigate the compatibility of the grooved coupling gasket material for the intended application.

! NOTE A gasket/joint lubricant is recommended to prevent pinching the gasket and to assist the seating and alignment processes during assembly of grooved couplings. Certain lubricants may contain a petroleum base or other chemicals, which will cause damage to the plastic pipe, gasket and adapter. Harvel Plastics, Inc. suggests verifying the suitability for use of the selected lubricant with the lubricant manufacturer.

Specialty Adapters

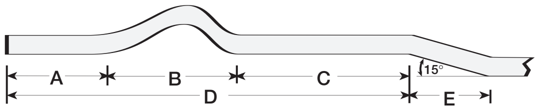
Specialty reinforced molded female adapters are available in PVC and CPVC for use as transition fittings to alternate materials. Unlike conventional plastic female adapters, these fittings incorporate the use of a stainless steel restraining collar located on the exterior of the FIPT threads of the adapter. This design allows direct connection to male metal threads without the need for pressure de-rating normally associated with conventional FIPT adapters, as the radial stress generated by thread engagement is contained. In addition, this style of fitting also helps to compensate for stresses that may be generated as the result of differences in dissimilar material thermal expansion/contraction rates and related stresses.

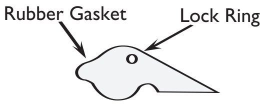
Gasketed Pipe

Low assembly force enables fast and simple field installation without the risk of gasket dislocation. Each spigot end of Harvel gasket pipe contains a 15° bevel for easy insertion, as well as a factory-placed reference mark to indicate proper insertion depth. The reference marks also provide a visual means to verify proper insertion if lines are assembled above ground, and lowered into the trench after assembly. Field-cut lengths must be cut square, beveled to the same 15° taper, and marked to the proper insertion depth.

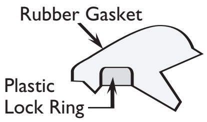
Dimensions

IPS (in.)	A	B	C	D	E (approx.)
Rieber Gasket					
2	0.590	1.329	2.820	4.739	0.474
2-1/2	0.670	1.489	2.860	5.019	0.566
3	0.708	1.587	2.940	5.235	0.688
4	0.867	1.723	3.020	5.610	0.874
6	1.063	2.076	3.200	6.339	1.274
8	1.260	2.073	3.500	6.833	1.500
Retained Ring Gasket					
10	1.875	2.417	4.750	9.042	1.500
12	2.000	2.619	5.500	10.119	1.500
14	2.125	3.375	6.000	11.500	1.500
16	2.250	2.875	6.500	11.625	1.500
18	2.500	3.062	7.000	12.562	1.500
20	2.750	3.375	7.375	13.500	1.500
24	2.203	3.781	8.000	13.984	1.500





Rieber gasket - 2"–8"
Laying length, 19'6" ± 2"



Retained Ring gasket - 10"–24"
Laying length, 19' ± 2"

Deflection

Harvel gasketed joints permit an angular deflection of 2° at the joint. Adequate deflection can usually be achieved for gentle curves by using the inherent flexibility of the pipe itself, without using joint deflection.

Thrust Blocking

All gasket-joint piping requires adequate thrust restraints to prevent movement from forces generated by changes in direction, valve operation, dead ends, reduction in pipe size, and other areas where thrusts can be developed. The size and type of thrust restraint depends on the pipe size, type of fitting, soil properties, and water-hammer possibilities. Keeping flow velocities at or below 5 ft/sec ,will help minimize surge pressures. Fittings and valves used to "make vertical changes in direction should be anchored to the thrust restraint to prevent outward and upward thrusts at the fitting junctures. In pressure lines, valves 3" in diameter and larger should be anchored to the thrust restraint to prevent movement when operated. Consideration should also be given for the proper support, anchoring, and thrust restraint for lines installed on slopes.

The size of thrust block required (in square feet) can be determined by dividing the total thrust developed (in psi) by the capacity of the soil (in pounds/square foot).

The most common method of thrust blocking involves the pouring of concrete (to the size of block required) between the pipe fitting and the bearing wall of the trench. Mechanical thrust restraint devices are also used, but must be of design for use with PVC pipe.

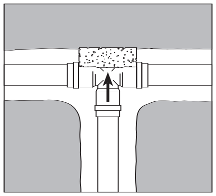
Thrust in lb. @ 100 psi Operating Pressure

Pipe Size (in.)	90° Bend	45° Bend	22.5° Bend	Tee, Cap Plug, 60°Bend
2	645	350	180	455
2-1/2	935	510	260	660
3	1,395	755	385	985
4	2,295	1,245	635	1,620
6	4,950	2.680	1,370	3,500
8	8,375	4,540	2,320	5,930
10	13,040	7,060	3,600	9,230
12	18,340	10,000	5,240	13,000
14	21,780	11,770	6,010	15,400
16	28,440	15,370	7,850	20,110
18	35,990	19,450	9,930	25,450
20	44,430	24,010	12,260	31,420
24	63,970	34,570	17,650	45,240

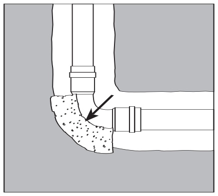
Safe Bearing Capacity

Soil	Capacity (lb./sq. ft.)
Muck, peat, etc.	0
Soft clay	1,000
Sand	2,000
Sand and gravel	3,000
Sand and gravel cemented with clay	4,000
Hard shale	10,000

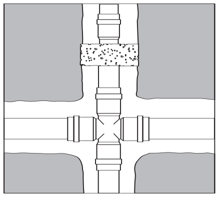
Thrust Blocks



Thru line connection, tee

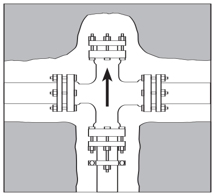


Direction change, elbow

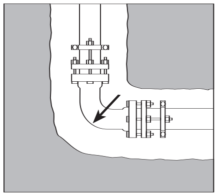


Change line size, reducer

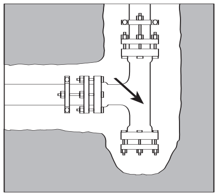
Thrust Retainers



Thru line connection, cross used as tee



Direction change, elbow



Direction change, tee used as elbow

Assembly of Gasketed Pipe

Step One: Make certain pipe ends and gasket areas are free of dirt and debris. Support spigot end of pipe above ground to prevent dirt contamination when lubricant is applied.

Step Two: Apply a light coating of recommended lubricant to spigot end and sealing section of gasket.

Step Three: Align pipe ends. Push spigot end into gasket bell so that the reference mark is even with the entrance of the gasket bell.

Pounds of Force Required to Assemble Harvel Gasket Pipe

Rieber		Retaining Ring	
Pipe Size (in.)	ft.-lb.	Pipe Size (in.)	ft.-lb.
2	113	10	250
2-1/2	124	12	300
3	137	14	385
4	157	16	360
6	284	18	450
8	352	20	520
		24	600

Gasket Pipe (Lubricant)

Nominal Pipe Size (in.)	Avg. Number of Joints Per Pint (1 lb.) Container of lubricant
2	70
2-1/2	60
3	50
4	35
6	20
8	14
10	10
12	7
14	5
16	3
18	2
20	1.5
24	1

Trenching — Initial Backfill

Trench depth is determined by the intended service and local conditions. Harvel gasket pipe should be buried a minimum of 12" below frost line in areas subject to freezing, or a minimum depth of 18"–24" where there is no frost. Permanent lines subjected to heavy traffic should have a minimum cover of 24". In areas not subject to freezing, a minimum cover of 12" to 18" is usually sufficient for small-diameter piping subjected to light traffic. Bearing stresses must be calculated to determine the amount of cover required. Reference to applicable local, state, or national codes is also recommended.

The trench bottom should be continuous, relatively smooth, and free of rocks and debris. Adequate backfill should be in place immediately after installation, prior to filling or testing the line, to help distribute the effects of expansion/contraction evenly over each pipe length. The initial backfill material should consist of particles of 1/2" in size or less, and properly tamped. Generally a minimum of 6"–12" of backfill is desirable for the initial phase. Where hardpan, ledge rock, or large boulders are encountered, the trench bottom should be padded with sand or compacted fine-grain soils to provide adequate protection. Joints should be left exposed for visual inspection during testing.

Testing should be done before final backfill.

Testing

If separate tests are to be conducted for pressure and leakage, pressure testing should be conducted first.

⚠ WARNING Air must be completely vented from the line prior to pressure testing; entrapped air can generate excessive surge pressures that are potentially damaging and can cause bodily injury or death. Air relief valves should be provided. The use of compressed air or gases for testing is not recommended.

Harvel suggests testing sections of pipe as it is installed to verify proper installation and joint assembly.

Make certain the section of piping to be tested is backfilled sufficiently to prevent movement under test pressure. If concrete thrust blocks are utilized, allow sufficient time for concrete to set up prior to testing. Test ends must be capped and braced properly to withstand thrusts developed during testing.

Final Backfill

Backfilling should be conducted in layers; each layer must be compacted sufficiently so that lateral soil forces are developed uniformly. Under certain conditions it may be desirable to pressurize line during the backfill operation. Vibratory methods are recommended when compacting sand or gravel. Sand and gravel containing a significant proportion of fine-grained materials (silt, clay, etc.) should be compacted by mechanical tampers. When water flooding is used, sufficient cover must be provided by the initial backfill to ensure complete coverage of the pipe; precautions must be taken to prevent "floating" the pipe in the trench. Additional layers of backfill should not be applied until the water-flooded backfill is firm enough to walk on.

In all cases, the backfill should be placed and spread in uniform layers to eliminate voids. Large rocks, frozen dirt clods, and other debris larger than 3" should be removed to prevent damage to the pipe. Rolling equipment or heavy tampers should only be used to consolidate the final backfill. Additional information pertaining to underground installation is contained in ASTM D2774 (Underground Installation of Thermoplastic Pressure Pipe), and ASTM D2321 (Underground Installation of Flexible Thermoplastic Sewer Pipe).

Water Volume Gallons per 100 Feet

Pipe Size (in.)	Sch. 40	Sch. 80	Sch. 120	SDR. 21	SDR. 26	SDR. 41
2	17	15	14	19	20	–
2-1/2	25	22	21	28	29	–
3	38	34	32	41	43	–
4	66	60	54	68	70	–
6	150	135	123	146	152	–
8	260	237	–	248	258	–
10	409	373	–	–	401	–
12	582	528	–	–	565	–
14	703	637	–	–	681	–
16	917	836	–	–	889	–
18	–	1060	–	–	1125	1195
20	–	–	–	–	1390	1475
24	–	–	–	–	2000	2125

Underground Installation

Underground piping must be installed in accordance with any applicable regulations, ordinances and codes. Since piping is installed in a wide range of subsoils attention should be given to local pipe laying techniques which may provide a solution to a particular pipe bedding issue. The following information is applicable to PVC and CPVC piping joined via the solvent cementing method and may be considered as a general guide. Refer to Gasketed Pipe section for additional information pertaining to installation of gasketed pipe.

Inspection: Before installation, PVC and CPVC piping products should be thoroughly inspected for cuts, scratches, gouges or split ends which may have occurred to the products during shipping and handling. Do not use damaged sections. Damaged sections found must be cut-out and discarded.

Trenching: The trench should be of adequate width to allow convenient installation, while at the same time being as narrow as possible. Minimum trench widths may be utilized by joining pipe outside of the trench and lowering it into the trench after adequate joint strength has been achieved.

! NOTE Refer to manufacturer's instructions for recommended set and cure time for solvent cement joints.

Trench widths will have to be wider where pipe is joined in the trench or where thermal expansion and contraction is a factor.

Trench depth is determined by intended service and local conditions. In all cases, thermoplastic pipe should be installed at least below frost level. Pipe for conveying liquids susceptible to freezing should be buried no less than 12" below the maximum frost level. Permanent lines subjected to heavy traffic should have a minimum cover of 24". For light traffic 12" to 18" is normally sufficient for small diameter pipe (typically < 3" diameter). With larger sizes, bearing stresses should be calculated to determine cover required. Reliability and safety should always be considered, as well as local, state, and national codes.

- Water filled pipe should be buried at least 12" below the maximum expected frost line.

- It is recommended that thermoplastic piping be run within a metal or concrete casing when it is installed beneath surfaces that are subject to heavy weight or constant traffic such as roadways and railroad tracks. Piping systems must be designed and installed to ensure they can handle anticipated loads. Refer to Critical Collapse Pressure Ratings under Engineering & Design Data for additional information.

The trench bottom should be continuous, relatively smooth and free of rocks. Where ledge rock, hardpan or boulders are encountered, it is necessary to pad the trench bottom using a minimum of four (4) inches of tamped earth or sand beneath the pipe as a cushion and for protection of the pipe from damage.

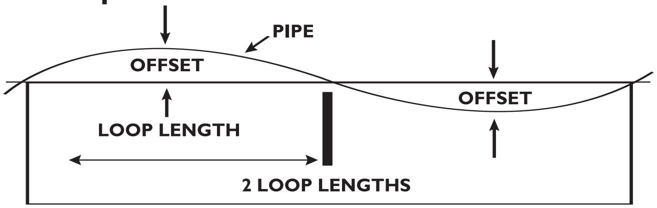
Sufficient cover must be maintained to keep external stress levels below acceptable design stress. Reliability and safety of service is of major importance in determining minimum cover. Local, state and national codes may also govern.

Snaking of Pipe: For small diameter piping systems (typically < 3" diameter), snaking of pipe is particularly important to compensate for thermal expansion and contraction of the piping when installing pipe in hot weather. This may also apply to larger diameter piping under specific applications and site conditions. After the pipe has been solvent welded and allowed to set properly, it is advisable to snake the pipe according to the following recommendations beside the trench during its required drying time (cure time). **BE ESPECIALLY CAREFUL NOT TO APPLY ANY STRESS THAT WILL DISTURB THE UNDRIED JOINT.** This snaking is necessary in order to allow for any anticipated thermal contraction that will take place in the newly joined pipeline. Refer to the section on Thermal Expansion & Contraction for additional information.

Snaking is particularly necessary on the lengths that have been solvent welded during the late afternoon or a hot summer's day, because their drying time will extend through the cool of the night when thermal contraction of the pipe could stress the joints to the point of pull out. This snaking is also especially necessary with pipe that is laid in its trench (necessitating wider trenches than recommended) and is backfilled with cool earth before the joints are thoroughly dry.

For Pipe Diameters < 3" diameter

Loop Offset in Inches for Contraction:



Maximum Temperature Variation, °F, Between Time of Solvent Welding and Final Use

Loop Length	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
	LOOP OFFSET									
20 Feet	3"	4"	5"	5"	6"	6"	7"	7"	8"	8"
50 Feet	7"	9"	11"	13"	14"	16"	17"	18"	19"	20"
100 Feet	13"	18"	22"	26"	29"	32"	35"	37"	40"	42"

! NOTE Expansion and contraction could become excessive in systems operating at near or at the maximum allowable temperature ranges with intermittent flow and buried lines. In these cases the lines should not be snaked. The use of properly installed expansion joints installed within suitable concrete pit is recommended for PVC and CPVC systems operating at or near upper temperature limits. A section of larger diameter PVC pipe or other suitable sleeve should be used over the carrier pipe to pass through the wall of the concrete. This will minimize the potential for damage (scratching & scarring) to the carrier pipe as the result of movement caused by thermal expansion/contraction. Expansion joints should be suitably anchored independently of the carrier line. Axial guides should be used to direct movement into the expansion joint.

Backfilling: Where possible, underground pipe should be thoroughly inspected and tested for leaks prior to backfilling. Ideally, backfilling should only be done early in the morning during hot weather when the line is fully contracted and there is no chance of insufficiently dried joints being subject to contraction stresses.

The pipe should be uniformly and continuously supported over its entire length on firm, stable material. Blocking should not be used to change pipe grade or to intermittently support pipe across excavated sections.

Pipe is installed in a wide range of subsoils. These soils should not only be stable, but applied in such a manner so as to physically shield the pipe from damage. Attention should be given to local pipe laying experience that may indicate particular pipe bedding problems.

Backfill materials free of rocks with a particle size of 1/2" or less should be used to surround the pipe with 6" or 8" of cover. It should be placed in layers. Each soil layer should be sufficiently compacted to uniformly develop lateral passive soil forces during the backfill operation. It may be advisable to have the pipe under pressure, 15 to 25 psi during the backfilling.

Vibratory methods are preferred when compacting sand or gravels. Best results are obtained when the soils are in a nearly saturated condition. Where water flooding is used, the initial backfill should be sufficient to insure complete coverage of the pipe. Additional material should not be added until the water flooded backfill is firm enough to walk on. Care should be taken to avoid floating the pipe.

Sand and gravel containing a significant proportion of fine-grained material, such as silt and clay, should be compacted by hand or, preferably by mechanical tamper.

The remainder of the backfill should be placed and spread in uniform layers in such a manner to fill the trench completely so that there will be no unfilled spaces under or about rocks or lumps of earth in the backfill. Large or sharp rocks, frozen clods and other debris greater than 3" in diameter should be removed. Rolling equipment or heavy tampers should only be used to consolidate the final backfill.

Under certain conditions, it may be advisable to have the pipe under pressure during the backfilling operation.

! NOTE Use of threaded connections should be avoided in underground applications. Where transition to alternate materials is required the use of a flange component with suitable gasket is recommended. At vertical transitions from below ground systems to connections aboveground, follow aboveground installation procedures with regard to compensating for thermal expansion/contraction, weatherability, and proper support recommendations. Valves and other concentrated weight loads should be independently supported. Avoid excessive bending of pipe; excessive deflection of pipe and joints can reduce pressure bearing capability and cause failure.

Additional information on underground installations is contained in ASTM D2774 "Underground Installation of Thermoplastic Pressure Piping", ASTM F645, Standard Guide For "Selection Design and Installation of Thermoplastic Water Pressure Piping Systems", and ASTM D2321 "Underground Installation of Flexible Thermoplastic Sewer Pipe."

Above Ground Installation

Thermal Expansion & Contraction

The system must be designed and installed to compensate for movement as a result of thermal expansion and contraction. This is particularly true for above ground applications installed outdoors and within unoccupied buildings where ambient temperature swings can be significant. For example, a system installed in an unoccupied (i.e., un-heated) building during the winter months will expand considerably when temperatures rise. The direct opposite is true for systems installed at higher ambient temperatures where temperatures may fall considerably after installation. This fact must be addressed with proper system design to compensate for movement generated as the result of the effects of thermal expansion and/or contraction of the piping.

The rate of expansion does not vary with pipe size. In many cases this movement must then be compensated for by the construction of appropriate sized expansion loops, offsets, bends or the installation of expansion joints.

These configurations will absorb the stresses generated from the movement, thereby minimizing damage to the piping. The effects of thermal expansion and contraction must be considered during the design phase, particularly for systems involving long runs, hot water lines, hot drain lines, and piping systems exposed to environmental temperature extremes (i.e. summer to winter).

Calculating Linear Movement Caused by Thermal Expansion

The rate of movement (change in length) caused by thermal expansion or contraction can be calculated as follows:

$\Delta L = 12\,yl\,(\Delta T)$

Where:
ΔL = expansion or contraction in inches
y = Coefficient of linear expansion of piping material selected
l = length of piping run in feet
$\Delta T = (T_1 - T_2)$ temperature change °F

Where:
T_1 = maximum service temperature of system and
T_2 = temperature at time of installation (or difference between lowest system temperature and maximum system temperature – whichever is greatest)

Coefficient of Linear Expansion (y) of Various Harvel Piping Products (in/in/°F) per ASTM D696

Pipe Material	y
Harvel PVC Pressure Pipe (all schedules & SDR's) and PVC Duct	2.9×10^{-5}
Harvel CPVC Schedule 40 & Schedule 80 Pressure Pipe	3.4×10^{-5}
Harvel CPVC Duct	3.9×10^{-5}
Harvel CTS CPVC Plumbing Pipe	3.2×10^{-5}
Harvel Clear PVC Schedule 40 & Schedule 80 Pipe	4.1×10^{-5}
Harvel LXT UPW Pipe	3.9×10^{-5}

Note: Refer to appropriate physical Properties Tables for additional detailed information

Example 1: Calculate the change in length for a 100 foot straight run of 2" Schedule 80 PVC pipe operating at a temperature of 73°F; installed at 32°F.

$\Delta L = 12\,yl\,(\Delta T)$

Where:
ΔL = linear expansion or contraction in inches
y = 2.9×10^{-5} in/in/°F
l = 100ft
ΔT = 41°F (73°F – 32°F)

ΔL = 12 in/ft x 0.000029 in/in/ft x 100ft x 41°F

ΔL = 1.43"

In this example the piping would expand approximately 1½" in length over a 100 ft straight run once the operating temperature of 73°F was obtained.

Example 2: 100 foot straight run of 2" Schedule 80 CPVC pipe operating temperature 180°F; installed at 80°F

$\Delta L = 12\,yl\,(\Delta T)$

Where:
ΔL = linear expansion or contraction in inches
y = 3.4×10^{-5} in/in/°F
l = 100ft
ΔT = 100°F (180°F-80°F)

ΔL = 12 in/ft x 0.000034 in/in/ft x 100ft x 100°F

ΔL = 4.08"

In this example the piping would expand approximately 4" in length over a 100 ft straight run once the operating temperature of 180°F was obtained.

Compensating for Movement Caused by Thermal Expansion/Contraction

In most piping applications the effects of thermal expansion/contraction are usually absorbed by the system at changes of direction in the piping. However, long, straight runs of piping are more susceptible to experiencing measurable movement with changes in temperature. As with other piping materials, the installation of an expansion joints, expansion loops or offsets is required on long, straight runs. This will allow the piping system to absorb the forces generated by expansion/contraction without damage.

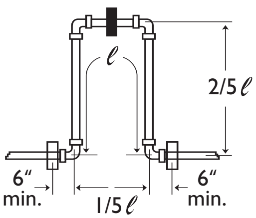
Once the change in length (ΔL) has been determined, the length of an offset, expansion loop, or bend required to compensate for this change can be calculated as follows:

$$\ell = \sqrt{\frac{3ED(\Delta L)}{2S}}$$

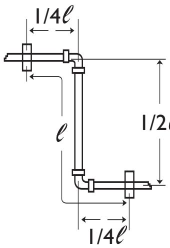
Where:

ℓ = Length of expansion loop in inches
E = Modulus of elasticity
D = Average outside diameter of pipe
ΔL = Change in length of pipe due to temperature change
S = Working stress at max. temperature

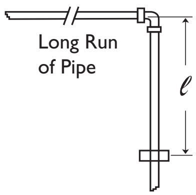
Loop



Offset



Bend (Change of Direction)



Hangers or guides should only be placed in the loop, offset, or change of direction as indicated above, and must not compress or restrict the pipe from axial movement. Piping supports should restrict lateral movement and should direct axial movement into the expansion loop configuration. Do not restrain "change in direction" configurations by butting up against joists, studs, walls or other structures. Use only solvent-cemented connections on straight pipe lengths in combination with 90° elbows to construct the expansion loop, offset or bend. The use of threaded components to construct the loop configuration is not recommended. Expansion loops, offsets, and bends should be installed as nearly as possible at the midpoint between anchors. Concentrated loads such as valves should not be installed in the developed length. Calculated support guide spacing distances for offsets and bends must not exceed recommended hanger support spacing for the maximum anticipated temperature. If that occurs, the distance between anchors will have to be reduced until the support guide spacing distance is equal to or less than the maximum recommended support spacing distance for the appropriate pipe size at the temperature used.

Example: 2" Schedule 80 CPVC pipe operating temperature 180°F; installed at 80°F where ΔL = 4.08"

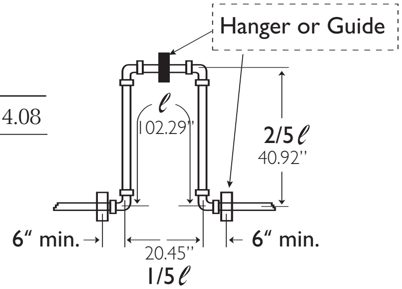
$$\ell = \sqrt{\frac{3ED(\Delta L)}{2S}}$$

$$\ell = \sqrt{\frac{3 \times 360{,}000 \times 2.375 \times 4.08}{2 \times 500}}$$

ℓ = 102.29"

2/5 ℓ = 40.92"

1/5 ℓ = 20.46"



For additional detailed information, refer to Harvel Product Bulletin 112/401 or visit our website at www.harvel.com.

Outdoor Applications

PVC and CPVC piping products have been used successfully in outdoor applications when proper recommendations are followed. As with any other piping, the system must be protected from freezing in applications subject to colder temperatures. Many standard cold weather piping design and installation practices can be used to protect the system from freezing such as use of pipe insulation, anti-freeze solutions, and heat trace tapes. The manufacturers of these products should be consulted for suitability and compatibility of their products for use with PVC and CPVC products prior to use.

Harvel recommends that PVC and CPVC piping products exposed to the effects of sunlight (UV radiation) be painted with a light colored acrylic or latex paint that is chemically compatible with the PVC/CPVC products. Compatibility information should be confirmed with the paint manufacturer. The use of oil-based paints is not recommended. When painted the effects of exposure to sunlight are significantly reduced, however, consideration should be given to the effects of expansion/contraction of the system caused by heat absorption in outdoors applications. The use of a light colored, reflective paint coating will reduce this affect, however, the system must also be designed and installed in such a manner to reduce the effects of movement due to thermal expansion. Refer to Temperature Limitations and Thermal Expansion & Contraction for additional information.

Hangers and Supports

Hanger Support Spacing

Proper support selection and spacing is critical to prevent stress concentration areas as the result of weight loading, bending stress, the effects of thermal expansion/contraction, and to limit pipe displacement (sag). As with all thermoplastic materials, proper pipe support spacing is dependent on pipe size, the location and magnitude of any concentrated weight loads, and the operating temperatures of the system due to the effects that temperature has on the tensile and compressive strength of the material. Increases in temperature require additional supports. When operating at or near maximum recommended temperature limits, it may be more economical to provide continuous support for the system via structural angle or channel that is free from rough or sharp edges. Local building codes should also be consulted for applicable requirements prior to installation.

Proper support spacing can be calculated similarly to that of metallic systems by using simple and continuous beam calculations. This can be achieved using the maximum fiber stress of the material, or deflection based on the long term modulus of the material at the temperature selected as the limiting factors.

Hanger Selection

Many hangers designed for metallic pipe are suitable for thermoplastics; however, hangers and supports used must provide an adequate load-bearing surface, which is smooth and free of rough or sharp edges that could damage the pipe. The use of improper supports can generate excessive sag resulting in failure. Movement caused by the effects of expansion and contraction of the system due to temperature variations, as well as movement as the result of pressure fluctuations must be considered to ensure proper hanger selection and placement. Hangers and supports used must permit axial movement of the system; they should not compress the pipe or otherwise restrict this movement.

Placement

Common practice is to install suitable hangers within two feet of each side of a pipe joint; changes in direction should be supported as close as possible to the fitting to reduce tensional stress. Heavy system components such as valves, flanged assemblies, tees and other forms of concentrated stress loads must be independently supported. In addition, valves should be braced adequately to prevent movement/stress loads as the result of operational torque. Consideration should also be given for certain processes where solids accumulation within the line is a possibility.

Precautions

The use of protective sleeves or pads between the pipe and the hanger may be desirable in certain applications, as their use will distribute stress loads over a greater surface area, particularly when using U-bolt or roller type hangers. Piping should not be permitted to contact abrasive surfaces that could cause damage during axial movement of the system. Protective sleeves or pads should be used when horizontal pipe is resting on concrete or other abrasive support structures. Contact with localized heat producing sources must also be avoided. Plastic piping systems shall not be installed in close proximity to steam lines or other high temperature equipment without providing appropriate protection to prevent damage from distortion and/or forces generated by the effects of expansion or contraction.

Vertical lines must be supported properly at intervals that will prevent excessive loading on the fitting at the lower end. Hangers and clamps suitable for this purpose include riser clamps or double bolt type clamps installed in such a manner that will allow for movement of the pipe due to thermal expansion and contraction. Clamps and hangers used must not compress, distort, cut or abrade the piping. Common practice is to install clamps just below a coupling so that the shoulder of the coupling rests on the clamp. Fittings can be modified in the field to achieve this by cutting a coupling in two, just above the stop at the socket bottom, and then cutting this piece in half lengthwise to provide two halves which do not contain the stop. The two halves are then solvent cemented to the pipe at the proper location so that the shoulder of the modified coupling rests on the clamp. Clamps used must not exert compressive stresses on the pipe; the use of riser clamps that utilize compression to the support the pipe weight are not recommended.

Anchor Guides

Anchors are utilized to direct movement of the piping by providing restraint at key points in the system. Their use may be required to control the effects of movement caused by expansion and contraction, forces generated by pressure surges, vibration, and other transient conditions. Anchors and guides are typically installed on long straight runs, at changes in direction of the system, and where expansion joints and other methods of thermal compensation are utilized. Guides are necessary to help direct this movement between anchors by allowing longitudinal movement while restricting lateral movement. Since guides act as supports, they should have the same load bearing surface and other requirements of hangers designed for the system. Guides must be rigidly attached to the structure to prevent lateral movement, but should not restrict longitudinal movement of the pipe through the guide. Anchors and guides must be engineered and installed in such a manor to perform adequately without point loading the system. Reference should be made to the section concerning thermal expansion and contraction for additional information.

Hanger Support Recommendations

Horizontal pipe system support spacing is greatly influenced by operating temperature. The charts show the recommended support spacing according to size, schedule, and operating temperatures. Do not clamp supports tightly – this restricts axial movement of the pipe. If short spacing is necessary, continuous supports may be more economical. Charts are based on liquids up to 1.00 specific gravity, but do not include concentrated loads, nor do they include allowance for aggressive reagents.

The following hanger support spacing recommendations are considered conservative in nature and are based on straight runs of un-insulated lines with fluids being conveyed that have a specific gravity of 1.00 or less. These values do not consider concentrated weight loads or aggressive reagents.

PVC PIPE SUPPORT SPACING (ft.)

PIPE SIZE (in.)	SCHEDULE 40				
	60°F	80°F	100°F	120°F	140°F
1/4	4	3-1/2	3-1/2	2	2
3/8	4	4	3-1/2	2-1/2	2
1/2	4-1/2	4-1/2	4	2-1/2	2-1/2
3/4	5	1/2	4	2-1/2	2-1/2
1	5-1/2	5	4-1/2	3	2-1/2
1-1/4	5-1/2	5-1/2	5	3	3
1-1/2	6	5-1/2	5	3-1/2	3
2	6	5-1/2	5	3-1/2	3
2-1/2	7	6-1/2	6	4	3-1/2
3	7	7	6	4	3-1/2
3-1/2	7-1/2	7	6-1/2	4	4
4	7-1/2	7	6-1/2	4-1/2	4
5	8	7-1/2	7	4-1/2	4
6	8-1/2	8	7-1/2	5	4-1/2
8	9	8-1/2	8	5	4-1/2
10	10	9	8-1/2	5-1/2	5
12	11-1/2	10-1/2	9-1/2	6-1/2	5-1/2
14	12	11	10	7	6
16	12-1/2	11-1/2	10-1/2	7-1/2	6-1/2
18	13	12	11	8	7
20	14	12-1/2	11-1/2	10	8-1/2
24	15	13	12-1/2	11	9-1/2

PIPE SIZE (in.)	SCHEDULE 80				
	60°F	80°F	100°F	120°F	140°F
1/4	4	4	3-1/2	2-1/2	2
3/8	4-1/2	4-1/2	4	2-1/2	2-1/2
1/2	5	4-1/2	4-1/2	3	2-1/2
3/4	5-1/2	5	4-1/2	3	2-1/2
1	6	5-1/2	5	3-1/2	3
1-1/4	6	6	5-1/2	3-1/2	3
1-1/2	6-1/2	6	5-1/2	3-1/2	3-1/2
2	7	6-1/2	6	4	3-1/2
2-1/2	7-1/2	7-1/2	6-1/2	4-1/2	4
3	8	7-1/2	7	4-1/2	4
3-1/2	8-1/2	8	7-1/2	5	4-1/2
4	9	8-1/2	7-1/2	5	4-1/2
5	9-1/2	9	8	5-1/2	5
6	10	9-1/2	9	6	5
8	11	10-1/2	9-1/2	6-1/2	5-1/2
10	12	11	10	7	6
12	13	12	10-1/2	7-1/2	6-1/2
14	13-1/2	13	11	8	7
16	14	13-1/2	11-1/2	8-1/2	7-1/2
18	14-1/2	14	12	11	9
20	15-1/2	14-1/2	12-1/2	11-1/2	9-1/2
24	17	15	14	12-1/2	10-1/2

PVC PIPE SUPPORT SPACING (ft.)

PIPE SIZE (in.)	SCHEDULE 120				
	60°F	80°F	100°F	120°F	140°F
1/2	5	5	4-1/2	3	2-1/2
3/4	5-1/2	5	4-1/2	3	3
1	6	5-1/2	5	3-1/2	3
1-1/4	6-1/2	6	5-1/2	3-1/2	3-1/2
1-1/2	6-1/2	6-1/2	6	4	3-1/2
2	7-1/2	7	6-1/2	4	3-1/2
2-1/2	8	7-1/2	7	7-1/2	4
3	8-1/2	8	7-1/2	5	4-1/2
3-1/2	9	8-1/2	7-1/2	5	4-1/2
4	9-1/2	9	8-1/2	5-1/2	5
5	10-1/2	10	9	6	5-1/2
6	11-1/2	10-1/2	9-1/2	6-1/2	6
8	12	11-1/2	10	7	6-1/2

PIPE SIZE (in.)	SDR 41				
	60°F	80°F	100°F	120°F	140°F
18	13	12	11	8	7
20	13-1/2	12-1/2	11-1/2	8-1/2	7-1/2
24	14	13	12	9	8

PIPE SIZE (in.)	SDR 26				
	60°F	80°F	100°F	120°F	140°F
18	14-1/2	14	12	9	8
20	15	14-1/2	12-1/2	9-1/2	8-1/2
24	15-1/2	15	13	10	9

NOTE Although support spacing is shown at 140°F for PVC, consideration should be given to the use of CPVC or continuous support above 120°F. The possibility of temperature overrides beyond regular working temperatures and cost may either make either of the alternatives more desirable. This chart based on continuous spans and for un-insulated line carrying fluids of specific gravity up to 1.00.

CPVC PIPE SUPPORT SPACING (ft.)

PIPE SIZE (in.)	SCHEDULE 40					
	73°F	100°F	120°F	140°F	160°F	180°F
1/2	5	4-1/2	4-1/2	4	2-1/2	2-1/2
3/4	5	5	4-1/2	4	2-1/2	2-1/2
1	5-1/2	5-1/2	5	4-1/2	3	2-1/2
1-1/4	5-1/2	5-1/2	5-1/2	5	3	3
1-1/2	6	6	5-1/2	5	3-1/2	3
2	6	6	5-1/2	5	3-1/2	3
2-1/2	7	7	6-1/2	6	4	3-1/2
3	7	7	7	6	4	3-1/2
3-1/2	7-1/2	7-1/2	7	6-1/2	4	4
4	7-1/2	7-1/2	7	6-1/2	4-1/2	4
6	8-1/2	8	7-1/2	7	5	4-1/2
8	9-1/2	9	8-1/2	7-1/2	5-1/2	5
10	10-1/2	10	9-1/2	8	6	5-1/2
12	11-1/2	10-1/2	10	8-1/2	6-1/2	6
14	12	11	10	9	8	6
16	13	12	11	9-1/2	8-1/2	7
18	14	13	12	10-1/2	9-1/2	8

PIPE SIZE (in.)	SCHEDULE 80					
	73°F	100°F	120°F	140°F	160°F	180°F
1/2	5-1/2	5	4-1/2	4-1/2	3	2-1/2
3/4	5-1/2	5-1/2	5	4-1/2	3	2-1/2
1	6	6	5-1/2	5	31/2	3
1-1/4	6-1/2	6	6	5-1/2	31/2	3
1-1/2	7	6-1/2	6	5-1/2	31/2	3-1/2
2	7	7	6-1/2	6	4	3-1/2
2-1/2	8	7-1/2	7-1/2	6-1/2	41/2	4
3	8	8	7-1/2	7	41/2	4
3-1/2	8-1/2	8-1/2	8	7-1/2	5	4-1/2
4	9	8-1/2	8-1/2	7-1/2	5	4-1/2
6	10	9-1/2	9	8	51/2	5
8	11	10-1/2	10	9	6	5-1/2
10	11-1/2	11	10-1/2	9-1/2	61/2	6
12	12-1/2	12	11-1/2	10-1/2	71/2	6-1/2
14	15	13-1/2	12-1/2	11	91/2	8
16	16	15	13-1/2	12	10	8-1/2
18	17	16	14-1/2	13	11	9-1/2

NOTE Although support spacing is shown at 140°F for PVC, consideration should be given to the use of CPVC or continuous support above 120°F. The possibility of temperature overrides beyond regular working temperatures and cost may either make either of the alternatives more desirable. This chart based on continuous spans and for un-insulated line carrying fluids of specific gravity up to 1.00.

Testing

⚠ WARNING

Use of compressed air or gas in PVC/CPVC pipe and fittings can cause explosive failures resulting in system damage, severe bodily injury, or death.

Hydrostatic pressure testing (testing with water filled lines) is the only test method recommended and approved for pressure testing Harvel PVC and CPVC piping products. During pressure testing appropriate safety precautions must be taken to protect personnel and property from damage should a failure occur. The test pressure and duration of the pressure test performed should meet requirements of any local, state, or federal regulations as applicable. In the absence of any such requirements or regulations the following procedures can be used to properly conduct a hydrostatic pressure test on newly installed PVC and CPVC piping systems.

Strict adherence to proper solvent cementing instructions and set and cure times is essential to ensure the highest system integrity prior to pressure testing. Particular attention should be paid to pipe sizes, temperature at time of installation and any temperature variations over the set and cure period.

- All solvent-cemented connections in the system must be fully cured properly prior to filling the system with water.
- Pipe must be adequately anchored/restrained to prevent movement during testing.
- The system should not be tested until authorized and subsequently witnessed by the responsible engineer.
- Extreme care shall be used to ensure complete venting of all entrapped air when filling the system with water. Entrapped air is a major cause of excessive surge pressures that result in burst failures of rigid plastic piping systems.
- Air must be removed from the system to prevent it from being locked in the system when pressure is applied.
- The system should include the use of air release and air/vacuum relief valves located at high points in the system to vent air during filling, as well as during normal operation of the system.
- The system must be filled slowly with water, venting air from valves at piping run ends and at elevations during the filling process. Whether a hydraulic hand pump or available water line pressure is used, any slow build-up of gauge pressure or any rapidly fluctuating gauge needle on a completely liquid filled system is a strong indication that entrapped air is present within the system. Should this occur, pressure should be immediately released and the line re-bled. Failure to do so can lead to a catastrophic failure when the water column is suddenly accelerated by the rapidly decom-pressing air should a faulty joint separate or other failure occur.
- A maximum test pressure of 150% of the maximum stated system design operating pressure is considered satisfactory. The test pressure selected must not exceed the working pressure rating of the lowest pressure rated component in the system (i.e. threaded components, flanges, unions, valves etc.). Reduced test pressures must be used for any elevated temperature testing due to field conditions affecting temperatures. Appropriate temperature de-rating factors must be applied to determine a suitable test pressure at elevated temperatures (>73˚F).
- A test period of two (2) hours is usually considered satisfactory to demonstrate the integrity of the system.
- If a leak is found the pressure must be relieved, the failed section cut-out, replaced, and allowed to cure properly prior to recharging and retesting the system.

Harvel recommends that large and/or complex systems be tested in segments as they are installed to permit evaluation and correction of improper installation techniques or other deficiencies as the project progresses. In buried applications the system should be hydro-statically tested prior to backfilling operations. During testing of buried lines, fittings and joints should be left exposed to aid in visual inspection for leakage. Sufficient earth cover should be placed over the pipe sections located between the fittings/joints to help prevent movement during testing. Any concrete anchors and/or thrust blocks must be allowed to cure completely prior to pressure testing.

WARNING

Compressed air or gases must never be used for testing of rigid PVC and CPVC piping systems (refer to Caution Areas section for additional information). Improper installation, especially poor workmanship in solvent cementing techniques, can lead to an abrupt release of tremendous stored energy in the presence of compressed air or gas. This abrupt release of energy creates a "whipping action" of the piping where shattering of pipe and fittings is then apt to occur at directional changes and at points where the system is rigidly restrained. This scenario creates a substantial safety hazard to personnel. In addition, secondary hairline stress fractures caused by this effect can also be initiated which will tend to propagate over time resulting in additional failures. It is also known that certain additives present in air compressor lubricants are not chemically compatible with PVC/CPVC materials and will initiate stress cracking of the plastic, further increasing the potential for additional failures. Refer to caution areas for additional information.

Chemical Compatibility Awareness

PVC and CPVC piping continue to gain wide acceptance and use in many different industries and applications, particularly increased use in commercial plumbing applications. As a result of increased use in the commercial construction environment, plastic piping products are exposed more frequently to contact with ancillary products as well as exposure to other trades. Occasionally certain chemicals found in construction products and specific site preparations can cause damage to plastic piping systems.

PVC and CPVC pipe materials can be damaged by contact with chemicals found in some construction and ancillary products such as thread sealants, lubricants, anti-freeze solutions, fire stop materials, etc. It is important to verify the compatibility of materials that come in contact with the plastic system to ensure long-term performance.

ALWAYS CHECK with Harvel Plastics, Inc. if you have questions regarding chemical compatibility. If chemical compatibility with the plastic remains in question, it is recommended to isolate the suspect product from direct contact with the PVC and CPVC pipe or fittings.

Compatibility Concerns:

In general, CPVC piping products may be more susceptible to stress cracking agents that can be found in certain ancillary products. The following list has been generated to create awareness that the potential for damage exists. Please note that a chemical compatibility program exists where a list of acceptable and unacceptable products is maintained. Please contact Harvel Plastics, Inc. Technical Services Department for the latest information.

Thread Sealants: Some thread paste sealants contain solvents or other chemical additives that can cause damage to PVC and CPVC. Only compatible thread sealants and tapes should be used.

Fire Stops Materials: Some fire stop sealants contain solvents or other chemical additives that can cause damage to PVC and CPVC. Only compatible fire stop materials should be used.

Anti-Freeze Solutions: DO NOT USE GLYCOL BASE ANTI-FREEZE SOLUTIONS. The use of improper anti-freeze solutions such as ethylene glycol, propylene glycol and/or contaminated glycerin solutions can cause stress cracking of PVC and CPVC resulting piping system failure. Anti-Freeze solutions of U.S.P. or C.P. grade GLYCERIN are acceptable for use with CPVC fire sprinkler products. Refer to appropriate NFPA Standards concerning Anti-Freeze Systems and the CPVC manufacturers installation instructions for additional information.

Soldering/Hot Work: Soldering of metallic components in close proximity to PVC and CPVC piping will cause damage to the plastic piping systems. Direct contact with heat (open flame), solder, and soldering flux is not recommended. These types of products should be isolated from direct contact with PVC and CPVC piping products. PVC and CPVC contact with solder flux can cause cracks, leaks and breaks in the piping system. Any PVC and CPVC pipe or fittings that have solder flux on them (as identified by staining or discoloration of the pipe and fittings) should be removed and replaced with new materials.

Flexible Wire: Direct contact with flexible wire and cable should be avoided as the insulation for the wire and cable can contain plasticizers that can cause PVC and CPVC piping systems to crack, leak or break. The finished installation should be inspected to verify that the plastic piping system is not being used to support wire or cable, and that runs of wire and cable have not been pulled over the installed PVC and CPVC system. Additionally, the PVC and CPVC piping systems should not be supported with electrical cable or flexible wiring, and all hanger support recommendations should be followed. Section 334.30 of the National Electric Code (2002 Edition) requires wire and cable to be secured by staples, cable ties, straps, or hangers. Air ducts, pipes and ceiling grid are not acceptable supports for wire and cable.

Steel Pipe Transitions: Transitions from steel pipe to PVC and CPVC pipe can be made through a variety of methods such as threaded, flanged, and grooved transition components. Occasionally steel pipe may contain residual oils that were used to aid in the metal cutting process. Some of the oils used for this purpose may be incompatible with PVC and CPVC. Cutting oils should be removed from steel pipe prior to connecting to PVC and CPVC pipe by fully cleaning the inside and outside of the pipe before it is assembled in the piping system. Care should be taken when selecting cleaning agents to avoid further contamination of the pipe with incompatible detergents. If cutting oil is used, consult with the manufacturer of the cutting oil for a specific recommendation as to compatibility with PVC and CPVC.

Paint: Oil or solvent-based paints may be chemically incompatible with PVC and CPVC. Water-based acrylic or latex paint is the preferred paint to use on PVC and CPVC pipe and fittings. The installation contractor must take responsibility for obtaining approval

from the Authority Having Jurisdiction to cover the markings on the product (i.e. product identification, listing marks, etc.) and to change color of the pipe and fittings from its identifiable color prior to use.

Cooking Oils and Grease: When CPVC pipe is installed in kitchen areas the pipe must be protected from contact with grease or cooking oils. Certain cooking oils can cause the CPVC piping to crack, leak or break when applied to the piping system. Consideration must be given to not only protecting the pipe from direct contact with cooking oils and/or grease, but also contact that may occur from airborne grease or oil from the environment such as cooking. Exposed piping in areas where CPVC pipe might come in contact with cooking oils and grease should be protected using a soffit system or with a complete coating of high quality water based paint that fully protects the piping system.

Rubber and Flexible Materials: CPVC is typically not compatible with rubber and flexible plastic materials as these materials often contain certain types of plasticizers which when placed in contact with CPVC can cause the piping system to crack, leak or break. (Incompatible plasticizers include, but are not limited to, phthalates, adipates, trimellitates, dibenzoates, etc.) Incompatible rubber and flexible plastic materials can be found in hoses and tank linings and in the fluids that come in contact with them.

Spray On Coatings: Certain types of spray-on coatings that form a peelable film to protect fixtures during construction may be incompatible with CPVC. Care should be used to protect exposed piping from over-spray when this type of protective coating is applied.

Termiticides and Insecticides: When performing installations underslab or where the presence of insecticides or termiticides is likely, care should be taken to isolate PVC and CPVC pipe from direct contact with large quantities of these chemicals. PVC and CPVC can be damaged when termiticides or insecticides are injected into the annular space between the pipe wall and sleeving material trapping the termiticide against the pipe wall. Termiticide applications per label instructions in an open-air environment, such as slab pretreat applications, should not pose a problem. However, puddling of termiticides on or near PVC and CPVC pipe may cause failures. In areas where puddling is more likely, such as areas near tub boxes and retreat applications, extra care should be taken to avoid puddling of termiticides Before using an insecticide or termiticide, be sure to consult the manufacturer's installation guide for proper application instructions. A list of compatible insecticides or termiticides is available. Additional precautions need to be taken when retreat applications are required. Termiticide retreatment is usually required when the concrete slab has been broken to relocate a pipe. The following recommendations should followed in retreat applications:

- Remove all the plastic barrier material that was installed prior to the initial concrete pour from the area to be retreated. Do not reinstall the plastic barrier material.
- After the pipe has been relocated, the soil should be pretreated before it is placed in the hole around the pipe. Do not apply termiticide directly to the retreat area.

In situations where sleeving is required, the pipe should be protected with a compatible sleeving material extending at least 12" above and below the soil. The top of the sleeving should be securely taped to the pipe with a compatible tape product. Backfill over underground piping prior to termiticide spraying.

Mold Abatement and Fungicides: Building restoration projects used to repair water damage often include the use of mold abating products such as fungicides. These products can damage PVC and CPVC piping systems and can cause cracks, leaks, or breaks in the system. When performing repairs or modifications care should be taken to isolate the plastic piping system from direct contact with fungicide products. When repairs are made to an existing system, and the possibility exists that fungicides will be applied to treat damp drywall and wood framing surrounding the repair site, exposed piping should be sleeved with a compatible plastic sleeving or pipe insulation material to prevent direct contact of the fungicide with the plastic piping system.

For additional information on Chemical Compatibility Awareness contact Harvel Technical Services at 610-252-7355, or visit the Technical Support page on our website at: Harvel.com

General Safety Information

Thermoplastic piping is a general term applied to a variety of different plastics. A user of plastic piping should select the kind of plastic best suited for his use. Special care must be used to apply proper engineering, design and installation procedures.

Harvel recommends against the use of its thermoplastic piping systems for transport or storage of compressed air or gases. Entrapped air must be removed from liquid piping systems so that no air remains locked in the system when pressure is applied to the liquid. Excessive surge pressure must be avoided. Surge pressure can develop if liquid movement through the pipe is near maximum velocities and valves are closed abruptly. Maximum velocity is generally considered to be five feet per second.

Failures can occur at the joints connecting the pipe and the fittings. For example, threaded joints have a diminished wall thickness because of the cut of the thread into the wall. Also, improperly cemented joints will leave the strength of the joint impaired.

Temperature extremes, both hot and cold or changes in temperature can result in failures of plastic pipe in the following cases:

(1) Breakage or other damage on the job site in cold weather can be caused by impact with tools, vehicles or rocks.

(2) Heat of solution of chemicals or heat from other sources can cause failure because the piping systems will be distorted.

(3) Wide variations in temperature when the pipe is restrained as in concrete or is otherwise anchored can lead to cracking and breakage.

(4) Freezing of pipe contents when the line is full can lead to breakage.

(5) When heat is introduced by a pump especially when on recirculation, the pipe or joints can fail.

(6) Expansion and contraction can cause leakage or breaks at joints.

Crush strength of the plastic pipe and fittings should not be exceeded. Similarly, excessive suction or vacuum must be avoided. Since plastics are relatively soft they can be damaged using pipe wrenches on threaded connections. Pipe should not be used as a "ground" for electrical systems and conditions of "static electricity" should not be created through excessive friction. Welding or torch cutting operations near plastic pipe can cause damage to the pipe due to burning by sparks or overheating. High chromic acid solutions and high nitric acids can lead to stress cracking; also, when certain chemicals and solvents are absorbed into the pipe and fittings surfaces, a softness will develop in the plastic which can lead to weeping or rupture.

Proper trenching and backfilling procedures will provide a level and clean bed and will avoid impact and cutting from large or sharp rocks.

When using cement in making pipe joints, follow in detail the instructions in the solvent cement pamphlet.

SAFETY INFORMATION ON PRIMERS AND SOLVENTS

Over a period of 30 years, millions of solvent cemented joints have been made with only rare cases of mishap. However, since these products are flammable and contain chemical solvents, appropriate safety precautions should be taken.

Virtually all solvent cements and primers for plastic pipe are flammable and should not be used or stored near heat, spark or open flames. Do not smoke during use. Cement should be stored in closed containers at temperatures between 40˚F and 110˚F. They should be used only with adequate ventilation. In confined or partially enclosed areas, a ventilating device should be used to remove vapors and minimize their inhalation.

Respirators especially designed to minimize the inhalation of organic vapors can also be used, They are commercially available.

Containers should be kept tightly closed when not in use and covered as much as possible when in use. Use of an applicator can with applicator attached to a lid is especially recommended.

Avoid frequent contact with skin and eyes. May be absorbed through the skin. May cause eye injury. In case of contact, flush with plenty of water for 15 minutes. If irritation persists, get medical attention. If swallowed, call a physician immediately and follow precautionary statement given on side panel of cement container. Keep out of reach of children.

⚠ WARNING

USE CAUTION WITH WELDING TORCHES

At construction sites where plastic pipe is being installed or has recently been solvent welded, special caution should be taken where using welding torches or other equipment where sparks might be

involved. Flammable vapors from cemented joints sometimes linger within or around a piping system for some time.

Special care must be taken when using a welding torch in these application:

- Well casing installations
- Installing pumps in irrigation water lines
- Installation of plastic pipe systems in industrial plants

In all cases, lines should be purged to remove solvent vapors before welding.

⚠ WARNING

USE CAUTION WITH CALCIUM HYPOCHLORITE

Do not use a dry granular calcium hypochlorite as a disinfecting material for water purification in potable water piping systems. The introductions of granules or pellets of calcium hypochlorite with solvent cements and primers (including their vapors) may result in violent chemical reactions if a water solution is not used. It is advisable to purify lines by pumping chlorinated water into the piping system—this solution will be nonvolatile.

Furthermore, dry granular calcium hypochlorite should not be stored or used near solvent cements or primers.

Actually, solvent cementing is no more dangerous than putting gasoline in your automobile. People have learned they must be careful with gasoline. Although solvent cements are not as flammable as gasoline—users must learn to be careful. Again, accidents and injuries have seldom occurred in the use of our products. Help maintain and improve this excellent record by following the above recommendations.

USE OF COMPRESSED AIR OR GAS WITH HARVEL PVC/CPVC PIPING PRODUCTS

⚠ WARNING

The use of plastic piping in these types of devices can result in severe bodily injury or death.

Harvel's PVC and CPVC piping products are "rigid" thermoplastic materials. Harvel Plastics, Inc. does not recommend the use of PVC or CPVC piping products for the testing, transport, or storage of compressed air or gases. The compressibility of air and/or other gases result in tremendous amounts of stored energy, even at lower pressures. Should a failure occur in a compressed air or gas system for any reason (i.e. improper assembly, mechanical damage etc.) the failure mode will be very dramatic in nature due to the physical characteristics of the rigid piping in combination with the immediate release of this stored energy. Under these conditions, the velocity created by rapidly escaping air and the resultant failure mode can throw shards of plastic in multiple directions (i.e. shrapnel/ projectiles). This scenario creates a substantial hazard to personnel and property within the vicinity of the piping should a failure occur. Several cautionary statements and alerts against the use of rigid PVC/CPVC piping for use with compressed air or gases are available through the Plastic Pipe Institute (PPI), American Society for Testing and Materials (ASTM), various other trade organizations, manufacturers, safety codes, as well as several State and Federal Agencies (i.e. OSHA).

Compressed air or other gases should never be used in testing. Extreme care should be used to assure complete venting of all entrapped air when filling the system with water or other liquids used in testing. Whether a hydraulic hand pump or available water line pressure is used, any slow build-up of gauge pressure on a completely liquid filled line shows some entrapped air in the system. Pressure should be immediately released and the line re-bled. Failure to do this can lead to a catastrophic failure when the decompressing gas suddenly accelerates the solid water column if a faulty joint separates.

PVC and CPVC piping systems are not recommended for compressed air lines. Improper installation, especially poor cementing techniques can lead to an abrupt release of tremendous stored energy. Shattering of pipe and fittings is then apt to occur at directional changes and at points where the system is rigidly restrained due to the instantaneous whipping action imparted by the escaping air. Internal surface cracks, due to the stress, can be initiated which will tend to propagate and cause shattering, hairline or pinhole cracks over a period of time. There is also evidence that certain additives to system lubricants will initiate internal stress cracking which will again lead to similar failure over extended periods of time.

MSDS for Harvel Products

FINISHED PROFILE, BAR STOCK, DUCT, ANGLE, JOINING STRIP, and PIPE MADE FROM RIGID PVC and CPVC THERMOPLASTIC SECTION I

Manufacturer's Name: Harvel Plastics, Inc.

Telephone Number: (610) 252-7355 FAX: (610) 253-4436

Address: PO. Box 757, Easton, PA 18044-0757

Chemical Family: Ethene, chloro-(homopolymer and chlorinated)

Formula: Mixture of PVC or CPVC polymer with functional additives.

TRADE DESIGNATION

Chemical Name/Synonyms: Polyvinyl chloride, PVC and chlorinated polyvinyl chloride CPVC.

NFPA 704[1]: Health: 2 / Flammability: 1 / Reactivity: 0 / Special: None

HMIS[2]: Health: 0 / Flammability: 1 / Reactivity: 0

Hazard Code Key: 0 = Insignificant; 1 = Slight; 2 = Moderate; 3 = High; 4 = Extreme, 1 National Fire Protection Association, 2 National Paint and Coatings Association.

SECTION II- HAZARDOUS INGREDIENTS

All ingredients are bound-up in the manufacturing process and are not expected to create any hazard in handling or use. Finished goods (e.g., rigid pipe, bar stock, duct, a ngle, joining strip, or profile) are inert.

SECTION III- PHYSICAL DATA (Typical data, not specifications)

Boiling Point: Not applicable (NA)

Melting Point: NA

Specific Gravity: (H_2O = 1) 1.35-1.55

Solubility in Water: Insoluble

% Volatile by Weight: NA

Vapor Density: (Air = 1) NA

Vapor Pressure: (mm Hg) NA

Particle Size: NA

pH: NA

Appearance and Odor: Rigid pipe, bar stock, duct, angle, joining strip, or profile. No odor.

SECTION IV-FIRE AND EXPLOSION HAZARD DATA

Flashpoint: Not applicable to solid products

Ignition Temperature:

PVC: >730˚F (>388˚C) CPVC: >830˚F (>433˚C)

Flammable Limits in Air: (% by volume) Lower: NA Upper: NA

Extinguishing Media: Water. ABC dry chemical. AFFF. Protein type air foams. Carbon Dioxide may be ineffective on larger fires due to a lack of cooling capacity, which may result in re-ignition.

Special Firefighting Procedure: Wear positive pressure self-contained breathing apparatus (SCBA). Personnel not having suitable respiratory protection must leave the area to prevent significant exposure to toxic combustion gases from any source. In enclosed or poorly ventilated areas, wear SCBA during cleanup immediately after a fire as well as during the attack phase of firefighting operations.

Unusual Fire and Explosion Hazards: None known.

SECTION V-HEALTH HAZARD DATA

Threshold Limit Value: None established.

Effects of Overexposure: There are no significant health hazards from vinyl compound at ambient temperature. Inhalation of decomposition or combustion products, especially hydrogen chloride, will cause irritation of the respiratory tract, eyes and skin. Depending on the severity of exposure, physiological response will be coughing, pain and inflammation. Individuals with bronchial asthma and other types of chronic obstructive respiratory diseases may develop bronchspasm if exposure is prolonged.

Emergency and First Aid Procedure: If irritation persists from exposure to decomposition products, remove the affected individual from the area. Provide protection before reentry.

SECTION VI-REACTIVITY DATA

Stability: Stable

Hazardous Polymerization: Will not occur.

Hazardous Decomposition Products: CO, CO2, hydrogen chloride, and small amounts of benzene and aromatic and aliphatic hydrocarbons. CPVC may also contribute small amounts of chloroform and carbon tetrachloride.

Incompatibility (materials to avoid): Refer to Harvel Chemical Resistance Guide for chemical resistance information about Harvel thermoplastic pipe.

SECTION VII--SPILL OR LEAK PROCEDURE

Steps to be taken in case material is released or spilled: Material is inert. Place into a container for reuse or disposal.

Waste Disposal Method: Dispose of waste in accordance with federal, state and local regulations. For waste disposal purposes these products are not defined or designated as hazardous by current provisions of the Federal Resources Conservation and Recovery Act (RCRA) 40CFR261.

SECTION VIII--SPECIAL PROTECTION INFORMATION

Ventilation: Provide efficient exhaust at all operations capable of creating fumes or vapors. Cutting or sawing, machining, heat welding, thermoforming and other operations involving heat sufficient to result in degradation should be examined to ensure adequate ventilation.

Respiratory Protection: Not normally required. If overheating results in decomposition resulting in smoke or fumes, a NIOSH/MSHA approved combination high efficiency particulate filter with organic vapor cartridge can be used. Gross decomposition may require the use of a positive pressure self-contained breathing apparatus.

Protective Equipment: Wear safety glasses.

SECTION IX-SPECIAL PRECAUTIONS

Certain operations, such as the installation of piping systems, may require the use of solvent cements. The user must obtain and comply with all safety precautions recommended by solvent cement manufacturers. Avoid continued or prolonged breathing vapors produced by overheating.

SECTION X--TRANSPORTATION

For domestic transportation purposes, these pro-ducts are not defined or designated as a hazardous material by the U.S. Department of Transportation under Title 49 of the Code of Federal Regulations, 1983 Edition.

DOT Proper Shipping Name: Not applicable

DOT Hazard Class: Not hazardous

DOT Label: None required

UN/NA Hazard No.: Not applicable

Disclaimer of Liability

As the conditions or methods of use are beyond our control, we do not assume any responsibility and expressly disclaim any liability for any use of this material. Information contained herein is believed to be true and accurate but all statements or suggestions are made without warranty, expressed or implied, regarding accuracy of the information, the hazards connected with the use of the material or the results to be obtained from the use thereof. Compliance with all applicable federal, state and local laws and regulations remains the responsibility of the user.

Safety Alerts

Several varieties of safety alerts and related messages appear in this catalog. Please be sure you understand the meaning of the keywords that identify each type of alert.

⚠ WARNING

"WARNING" signifies hazards or unsafe practices that can cause severe personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION

"CAUTION" signifies hazards or unsafe practices that can cause minor injury or product or property damage if instructions, including recommended precautions, are not followed.

! NOTE

Use of the word "NOTE" signifies important special instructions.

⚠ WARNING

Use of compressed air or gas in PVC/CPVC pipe and fittings can result in explosive failures and cause severe injury or death.

The data furnished herein is provided as a courtesy and is based on past experience, limited testing, and other information believed to be reliable. This information may be considered as a basis for recommendation only. No guarantee is made as to its accuracy, suitability for particular applications, or the results to be obtained therefrom. Materials should be tested under actual service conditions to determine suitability for a particular purpose.

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Assessed to ISO 9001

REP4/12/10(15M); 9/15/09(5M)