ASSEMBLY & INSTALLATION

INSTALLATION OVERVIEW

Solvent cemented joints can only be successful if all procedures are followed properly. Threaded joints are limited in use. Teflon®-taped joints are recommended. It is easy to over-tighten and damage joints due to leverage of the tapered threads. Never transition from metal to plastic with male metal to female plastic threads. Male metal threads will split female plastic threads. Valves, flanges, unions and strainers are heavy-duty components with pressure ratings different than pipe because of mechanical sealing requirements. Flanges require proper gaskets, washers and bolts which must be tightened in a specific sequence to avoid leakage or breakage. Other considerations include thrust blocking for gasket joints, support spacing, entrapped air bleed points, trenching requirements and avoidance of residual mechanical stress on pipe or joints.

STORAGE AND HANDLING

Colonial thermoplastic fittings should be stored in their original cartons or in separate bins in a well-ventilated area. If stored in a vehicle or shed with little or no ventilation, excessive temperature build-up can cause fittings to warp.

Avoid dropping fittings on hard surfaces. Thermoplastics in general, have lower impact strength and less resistance to mechanical abuse than metals.

JOINING METHODS OVERVIEW

- Solvent Cementing
- Threading
- Flanging

SOLVENT CEMENTING

This method is most widely used. Pipe and fitting are coated with primer and cement and then assembled. Testing and use of the system can commence after proper cure time has elapsed.

THREADING

This method is used in areas that need to be disassembled periodically. It is also used in some cases to join dissimilar materials.

Since the threading process removes half the wall thickness from the pipe and fitting, threaded systems need to be derated to half that of equivalent sized pipe. Do not attempt to thread Sch 40 pipe; use Sch 40 male adapters instead. Sch 40 male adapters have a wall thickness under the threaded portion equivalent to the wall thickness under the threaded portion of Sch 80.

FLANGING

This method offers the same advantages as threading. Flanges can be installed on the pipe by either solvent cementing or by threading. Flanged systems are limited to 150 psi system pressure @73°F.

SOLVENT CEMENTING

RULES AND PRINCIPLES

The first rule of solvent cementing is “Do not take short cuts.” Taking short cuts in the cementing procedure is analogous to driving a car with only three of five lug nuts on each wheel. Taking short cuts may save you seconds but could cost you thousands of dollars. Understanding the principles of assembly prior to performing the actual cementing process is also recommended.

Assemble some test samples to evaluate yourself and/or your crew. After cementing several samples, preferably the largest size you will encounter, cut them in half and pry them apart. The pipe and fitting surfaces should be uniformly dull in appearance. If this is the case then you have created a strong chemical bond between the pipe and fitting. If shiny patches are seen then a proper bond was not made and it’s likely the fitting would leak.

When cemented with good cement under reasonable field conditions, fully cured and properly made joints should never blow apart when tested.

FYI

Make sure the thread sealant you use states on the container that it is compatible with the type of plastic you are using (e.g. PVC, CPVC, etc.). Several brands of thread sealant will cause plastic fittings to break.

FYI

If you have trouble getting a threaded fitting to stop leaking, try wrapping it in the normal way with Teflon® tape then apply a coat of compatible thread sealant. Tighten two turns past finger tight.

A properly made solvent weld joint will not pull apart. In fact, it is nearly twice as strong as the burst strength of the pipe.

CUTTING OF PIPE

Thermoplastic pipe can easily be cut at the job site by a number of methods: radial saw, band saw, hand saw or pipe cutter. Regardless of the method used it is important to cut the pipe square so that it will bottom out fully in the fitting socket. Cutting the pipe will raise burrs on the inside and outside edge. It is important to remove these burrs with a pocket knife or sharp-edged tool. If a pipe cutter is used, a rolled edge will form on the outside. This must be removed before assembly.

Please see page 36 for tips on installation of large diameter pipe and fittings.

Bevel (or chamfer) the outside edge from a 1/16" to 3/32" at a 10°-15° angle with a grinder or coarse file. Beveling the end of the pipe is *very* important. If not beveled, the sharp edge of the pipe will scrape cement from the socket wall during assembly and may cause the fitting to leak.

SURFACES TO BE JOINED MUST BE SOFT AND SEMI-FLUID

For the primer to adequately penetrate, it must be applied to the portions to be joined until they become soft and semi-fluid. Penetration can be tested on the pipe by performing a scrape test. Scrape off a portion of the primed pipe with a knife. Does it bring up a portion of the softened pipe with it? If not, keep applying primer until it does. Do not build a "stockpile" of pre-primed fittings. If the primer is allowed to dry before the cement is applied it is no longer effective. You must apply primer only at the time you are ready to assemble pipe and fittings.

SUFFICIENT CEMENT MUST BE APPLIED

Apply sufficient cement to both pipe and fitting socket. Application of too little cement will cause pipe and fitting to leak or separate. Application of too much cement will soften pipe and fitting and may cause failure.

ASSEMBLE WHILE SURFACES ARE STILL WET

Immediately after applying the cement, assemble the pipe and fitting. Failure to do so will result in a poor bond and possible leakage or joint separation.

JOINT STRENGTH DEVELOPS AS CEMENT CURES

As the cement cures, joint strength increases. If a system is pressurized before adequate cure time, the pipe and fitting may separate. Factors such as temperature, humidity and tightness of fit can effect cure times. Always follow cement manufacturer's recommendations.

USE THE RIGHT-SIZED APPLICATOR

One of the most common mistakes when cementing pipe and fittings is the use of the wrong-sized applicator. If too small of an applicator is used to apply primer and cement, then the curing process begins before complete coverage can be made. If too large of an applicator is used, most of the primer and cement is squeezed off the applicator as it is being pushed into a smaller fitting socket. This action usually results in inadequate application times of both primer and cement. Remember, small fittings also need adequate application time of primer to pre-soften for proper bonding.

Use an applicator that is approximately 1/2 the diameter of the pipe you are cementing. For example, use a 1" dauber or natural bristle brush when joining 2" pipe and fittings. Use a 4" brush or roller on 8" pipe and fittings. Do not use the dauber that comes with the can of cement unless it is of appropriate size. Many ill-fated attempts have been made to cement 6" pipe with a 1" dauber.

STEP-BY-STEP PROCEDURE FOR SOLVENT CEMENTING

Step 1: Pipe And Fitting Preparation
Remove fittings from the box and allow them to reach the same temperature as the pipe. Clean pipe ends and fitting sockets with a clean, dry cotton rag to remove dirt, grease or moisture.

Step 2: Dry Fit
Dry fit the pipe into the fitting socket. Fitting sockets are tapered to produce an interference fit with the pipe. This interference fit should be between one third and two thirds of the socket depth.

Sometimes when tolerances for pipe and fittings are at the extreme, it is possible to insert the pipe dry into the fitting socket until it fully reaches bottom. If this happens be sure to apply a sufficient quantity of cement to fill the gap between pipe and fitting. Inspect pipe and fittings for chips, gouges or deep scratches. If any are found tag, set aside and do not use.

Step 3: Marking
An indelible mark should be placed on the pipe equal to the socket depth of the fitting. This will indicate the area of the pipe to apply the primer and cement. It will also indicate when the pipe has fully bottomed in the fitting socket.

Step 4: Applying Primer
Using a proper-sized applicator, apply a coat of primer to the fitting socket then to the pipe and then a second coat to the fitting socket. Use a scrubbing action with the dauber or natural bristle brush to help ensure good penetration. It may take several repeat applications of primer (especially on a hot day) to ensure proper penetration of the primer.

Tip: Keep pipe and fitting socket pointed down during application of primer and cement. This prevents excess cement from running down inside the fitting.

Step 5: Applying Cement
Immediately apply a liberal coat of cement to the pipe, a moderate coat to the socket, and a second liberal coat to the pipe.

Step 6: Assemble Immediately
Without hesitation or delay, insert the pipe into the fitting socket giving the pipe a 1/4 turn until the pipe bottoms out. This turning action is to help distribute the cement more uniformly. The application of a 1/4 turn can only be used on fittings sizes up to 3”. Do not continue turning after the pipe touches the socket bottom.

WARNING

PRIMERS AND SOLVENT CEMENTS ARE EXTREMELY FLAMMABLE AND THE VAPORS CAN BE HARMFUL.

- DO NOT USE OR STORE NEAR HEAT OR OPEN FLAME.
- WORK ONLY IN A WELL-VENTILATED PLACE.
- AVOID CONTACT WITH EYES AND SKIN.
- INGESTION OR INTENTIONAL INHALATION CAN BE HARMFUL OR FATAL.
- REFERENCE ASTM F-402 FOR SAFE HANDLING PRACTICES.
- CONSULT MANUFACTURER FOR ADDITIONAL SAFETY RECOMMENDATIONS.

CAUTION

GENERAL WARNINGS

- COLONIAL DOES NOT RECOMMEND THE USE OF ALL-PURPOSE CEMENT.
- CHECK THE CEMENT CONTAINER LABEL FOR MAXIMUM PIPE SIZE.
- CHECK THE PRIMER AND CEMENT EXPIRATION DATE.
- DISCARD CEMENT IF NOTICEABLY THICKER OR HAS STARTED TO GEL IN THE CONTAINER.
- DO NOT MIX OLD AND NEW CEMENT. PROPERLY DISCARD OLD CEMENT.
- DO NOT MIX OLD AND NEW PRIMER. PROPERLY DISCARD OLD PRIMER.
- NEVER CEMENT IN DIRECT SUNLIGHT.
- DO NOT CEMENT DURING TEMPERATURE EXTREMES.
- KEEP CANS CLOSED WHEN NOT IN USE.
- USE THE PROPER-SIZED APPLICATOR.

Please see page 36 for tips on installation of large diameter pipe and fittings.

Step 7: Hold Together
Hold the pipe and fitting together for at least 30 seconds, longer if the pipe tries to back out of the socket. Because the socket is tapered, it produces a wedge effect which will try to push the inserted pipe out of the fitting socket.

Step 8: Remove Excess Cement
After assembly wipe excess cement from the pipe at the end of the fitting socket. Any gaps that show at this point may indicate an insufficient amount of cement was applied.

ABOUT PRIMERS AND SOLVENT CEMENTS

There are numerous varieties of solvent cements and primers available commercially. The recommendations of the individual cement manufacturers must be strictly adhered. Observe expiration dates because these products have a limited shelf life. Discard cement when there is a noticeable viscosity change or the formation of gels or stringers. Keep applicators (when in use) immersed in cement.

FYI

Primer cannot be applied the night before. It must be wet when cement is applied over the top of it.

Primer should be applied until the surface of the pipe begins to soften.

FYI

Cement should be applied twice to the pipe and once to the fitting socket. This little known procedure prevents excess cement from running inside the fitting. The excess cement on the pipe is forced out of the fitting socket during assembly.

Never use cement that starts to get thick and stringy or has started to gel.

JOINING PLASTIC PIPE IN HOT AND COLD WEATHER

Occasionally, pipe and fittings must be cemented together under less than desirable conditions. The following tips will help you make good solid joints under conditions of extreme hot or cold.

HOT WEATHER

Cementing operations should not be attempted where temperatures exceed 100°F. Primers and solvent cements dry out much quicker in hot weather. This is especially true when a hot wind is blowing. Surface temperatures of pipe and fittings stored in direct sunlight can easily exceed air temperatures by 20°F to 30°F. Solvents attack these surfaces quicker and deeper. For this reason, it is very important to prevent primer and cement from puddling inside the pipe or fitting body.

- Store solvent cements, primers, pipe and fittings in a cool or shaded place prior to use.
- Cool surfaces to be joined with a damp rag. Be sure to dry the surfaces thoroughly before applying primer and cement.
- Perform cementing in the cooler morning hours.
- Work quickly. With large diameter fittings, it may require two people; one person with the pipe and the other with the fitting.
- Use a heavier-bodied cement. These cements have longer cure times and therefore will provide more time for assembly.
- Set up an efficient work area to assist in quick assembly.

COLD WEATHER

Solvent cementing in sub-zero temperatures can be accomplished successfully if a few tips are followed. In cold weather, primer and cements penetrate slower than at room temperature. Plastics are resistant to solvent attack in colder environments. Therefore, it becomes even more important to follow directions carefully.

- Prefabricate as much as possible in a heated working area.
- Store primer and cement in a warm area when not in use and make sure they remain fluid.
- Remove any ice or snow.
- Continue to apply primer until good penetration can be seen from performing a scrape test.
- Allow for a longer cure time before using the system.
- A heat blanket may be used to speed up set and cure times.

SET TIME

Set time is the time required before moving or handling the assembled joint. As stated earlier, solvent cements develop joint strength over time. Once proper set time has passed, then the pipe and fitting can be moved or handled.

CURE TIME

Cure time is the time required before filling and pressurizing the system. For relative humidity greater that 50%, longer cure times are expected. Larger diameter pipe and fittings require longer set and cure time. Again, individual manufacturer's recommendations for their cement should be followed. It is the user's responsibility to determine that a joint has cured sufficiently for handling, testing and service.

BURIED APPLICATIONS

If pipe is to be buried, make as many joints as possible above the ground. Then, after joints have cured, carefully lower into trench.

"QUICK DRYING" AND "ONE-STEP" CEMENTS

In recent years, cement manufacturers have developed "quick drying" and "one-step" cements. These products have been used successfully in many applications. However, some field failures have occurred. In almost every case the failures were the direct result of improper assembly.

The names imply a certain benefit or ease-of-use. This is true, since the "quick drying" cements cure very quickly, they can be pressurized in a shorter time period. In the case of the "one-step" cements, the primer has been eliminated so it is easier to assemble.

In the case of “quick drying” or “one-step” cements, application time must be sufficient to provide good softening and penetration. Be sure to follow the specific cement manufacturer’s recommendations.

THREADED PLASTIC FITTINGS

Threaded pipe and threaded fittings should not be used in high pressure systems or in systems where a leak could endanger personnel. The process of making threads reduces the wall thickness of the pipe. The wall thickness in the threaded portion is only 50% of the pipe wall. For this reason, systems that use threaded pipe or threaded fittings must have at least a 50% reduction in pressure for equivalent pipe size. For example, a 2" sch 80 PVC pipe has a pressure rating of 400 psi unthreaded and 200 psi threaded.

Thermoplastic male threads are susceptible to breaking from bending stress. This is due to two things: 1) the stress concentrations produced by the sharp notch of the threads; 2) the reduction in strength due to the removal of material when making the thread. Extra care must be taken to prevent side loads or bending stress when using thermoplastic male threads.

PLASTIC PIPE THREADING TIPS

- Only thread pipe of Sch 80 or higher. Do not thread schedule 40 pipe. Sch 40 male adapters have a wall thickness under the threaded portion equivalent to the wall thickness under the threaded portion of sch 80.
- When cutting threads only use pipe dies designed for plastic pipe. Keep the dies clean and sharp. Do not use them on other materials.
- Use a vise that will hold the pipe with out damaging it. A standard metal vise should never be used. This type of vise can gouge and damage the pipe. Chain-type vises may be used providing the pipe is wrapped in a rubber sheet. The rubber sheet will not only protect the pipe from damage, but will also provide a non-slip grip on the pipe.

  The recommended type of vise and wrench is a strap type.
- Insert wooden plugs into the end of the pipe to ensure it maintains its shape during threading.
- Use a die that has a proper size guide to ensure it starts square to the pipe axis.
- Lubricate the cutting die. Make certain the type of lubricant used is compatible with the type of pipe material being cut. Check with the specific manufacturer for compatibility.
- Do not use soapy water or oils to lubricate thread dies. Certain types of these products may cause chemical stress cracking of the plastic.
- Never bury threaded fittings underneath areas of heavy traffic (e.g. driveways or parking lots). Constant loads will cause soil compacting over time and could damage threads through compression bending.
- Never run soil vibration compactors over buried threaded fittings.
- Make sure that the pipe alignment to the threaded fitting is square and suffers no bending stress.
- Only use an approved pipe thread sealant. Teflon® tape is the best choice. If Teflon paste is used, be certain to check the container for compatibility with the specific plastic you are threading. Certain brands of Teflon paste contain oils that will attack PVC and CPVC.

ASSEMBLY PROCEDURE (THREADED FITTINGS)

Threaded plastic pipe and fittings fall into two categories of application. The first is when they are used in all plastic systems. The second is when they are used to transition from metal to plastic. There are three possible combinations: 1) plastic male to plastic female (recommended); 2) plastic male to metal female (recommended); 3) metal male to plastic female (not recommended). Threading a metal male thread into a plastic female thread produces very high stress in the plastic fitting and is not recommended.

Why do metal male threads cause so much damage when threaded into plastic female threaded fittings? Why doesn’t a plastic male thread cause as much of a problem? The answer is that

FYI

Never pour cans of cement together to try and save a few pennies. The results could cost you thousands.

Never use metal pipe wrenches on plastic fittings. Only use strap wrenches. Metal pipe wrenches will damage plastic fittings by making them distort during tightening and by placing deep gouges in them.

FYI

One of the most frequently made mistakes is not beveling the end of the pipe. Beveling the end of the pipe breaks the sharp edge that often scrapes the cement off the socket wall. Pipe that is not beveled can cause cement jobs to leak or pull apart.

when plastic to plastic threaded fittings are tightened, the female fitting expands and the male fitting compresses. The stress is shared equally between the two. However, when a metal male thread is tightened into a plastic female thread the stress is not shared equally. Since metal has a much greater strength compared to plastic it does not compress when tightened. This places all the stress on the plastic female fitting.

FINGER TIGHT & HAND TIGHT

Molded plastic threads are already quite smooth and when a lubricant, like Teflon, is added it makes tightening even easier. In short, it is possible to over-tighten threaded plastic fittings by hand with Teflon tape/paste. The reason is that everyone has different strengths. What is finger tight for one is hand tight for another. The following procedure for assembling threaded fittings should help reduce the number of split threads from accidental over-tightening.

Step 1: Dry Fit
Before wrapping Teflon tape on the male threads, assemble both male and female to where they just start to tighten on the taper. Now count the number of turns it takes to disengage the two. Write this number on the fitting with a marker.

Step 2: Apply Teflon Tape Or Approved Thread Sealant
Wrap Teflon tape on the male thread in the normal way and reassemble to the number of turns required to disengage the two (from Step 1). Now tighten an additional 1-1/2 turns more and stop. Do not tighten beyond 1-1/2 turns. Doing so may damage the female plastic fitting causing it to fail. By following the above procedure you will be able to produce consistent leak-free threaded joints that will not fail from accidental over-tightening.

Hot Tip: For joints that are difficult to seal try the following method: Wrap a single layer of Teflon® tape in the normal way. Next, apply a coating of an approved thread sealant over the Teflon tape. The thread sealant helps lubricate the tape so that it doesn't tear during tightening. This is especially helpful with larger diameter threads (above 2"). The larger the diameter the more distance the tape must travel during assembly; the more distance traveled the more likely the tape will tear during assembly. Thread sealant over tape helps prevent this.

FLANGING

Thermoplastic flanges are used where the capability of periodic tear-down of a piping system is required. They have a maximum pressure capability of 150 psi @73°F. Thermoplastic flanges have bolt hole patterns that are compatible with those found in ANSI B-16.5. There are two methods of attaching flanges to pipe: solvent cementing (socket) and threading (NPT). Socket dimensions conform to ASTM D-2467 (PVC) and F-439 (CPVC), while thread dimensions conform to ANSI/ ASME B1.20.1. Flanges are available in two basic styles: Van Stone (two-piece) and companion (one-piece).

Van Stone flanges are unique in the fact that they allow bolt hole alignment after assembly. This is accomplished by the bolt ring being separate from the end piece. Solid one-piece flanges are not capable of this and therefore require thoughtful planning prior to assembly.

Use 1/8" thick full-face elastomeric gaskets to seal the flanges. Gasket hardness is recommended to be between 50 and 80 durometer. Care must be taken when joining flanges together, whether bolting plastic to plastic or metal to plastic. Any undue stress from misalignment, improper tightening or over-torquing can cause flange failure.

Use properly sized flat washers under every nut and bolt head. Failure to do so may lead to premature flange failure due to high stress concentrations. *In addition, omission of the proper size washers or failure to install the proper washer(s) will void Colonial's product warranty.* Bolts and nuts alone create a high stress point that not only cut into the plastic, but can cause failure in the flange. Washers distribute and reduce the bending force. See Table 18 for proper bolt, nut and washer sizes. Also note that bolt lengths differ between Van Stone and companion flanges.

Some metal and plastic butterfly valves and some flanges have raised areas near the inside sealing surface. This creates a ring gasket effect which is not recommended. To accommodate these types of valves and flanges, apply the lowest recommended torque value (e.g. If a range is given between 35 and 50 ft-lbs, use 35 ft-lbs). Use extreme caution when bolting this arrangement together because the unsupported area produces a bending stress on the flange ring.

FLANGE INSTALLATION

Clean and inspect flange sealing surfaces for dents and any other damage prior to assembly. Bolts and nuts should be clean and lubricated. Loosely assemble flanges with the gasket, making sure bolt holes freely align and that flange faces are parallel to each other. Make sure that one end of the system is free to move enough to allow the faces to come together during tightening. Do not hang excessive weight from a flange. These steps need to be taken to prevent mechanical loading on the pipe and flanges.

Tighten nuts in small increments with a wrench holding the bolt head and a torque wrench tightening the nut. Flange faces must remain parallel during bolt tightening. Uneven tightening will damage flanges. Tighten in a sequential, criss-cross manner. Maximum torque values are shown in Table 18. Over-torquing will damage flanges.

Table 18: Flanged Fittings Information

Pipe Size (in)	Max O.D. (in)	No. Bolt Holes	Dia. of Bolt Circle (in)	Dia. of Bolt (in)	Hex Head Bolt Length		Hex Nut Size (in)	SAE Flat-washer O.D. (in)	Rec. Torque (ft-lbs)
					Comp. (in)	Van Stone* (in)			
1/2	3.5	4	2.38	1/2	2		1/2	1-1/16	10-15
3/4	3.88	4	2.75	1/2	2		1/2	1-1/16	10-15
1	4.25	4	3.12	1/2	2		1/2	1-1/16	10-15
1-1/4	4.62	4	3.5	1/2	2-1/2		1/2	1-1/16	10-15
1-1/2	5	4	3.88	1/2	2-1/2	3-1/2	1/2	1-1/16	10-15
2	6	4	4.75	5/8	2-1/2	3-1/2	5/8	1-5/16	10-15
2-1/2	7	4	5.5	5/8	2-3/4	4	5/8	1-5/16	20-30
3	7.5	4	6	5/8	3	4	5/8	1-5/16	20-30
4	9	8	7.5	5/8	3-1/2	4	5/8	1-5/16	20-30
6	11	8	9.5	3/4	4	4-1/2	3/4	1-1/2	35-50
8	13.5	8	11.75	3/4	4-1/2	5-1/2	3/4	1-1/2	35-50
10	16	12	14.25	7/8	4-1/2	6-1/2	7/8	1-3/4	55-75
12	19	12	17	7/8	4-1/2	6-1/2	7/8	1-3/4	60-80

* Bolt length given is for Colonial flange to flange. Length may vary when connecting to other types and/or brands of flanges.

FYI

Avoid burying threaded fittings under areas of heavy traffic.

Flange bolt length requirements will vary from flange style to flange style. See Table 18 for proper bolt length. Note that the Van Stone flange has a longer bolt requirement than the standard companion flange. This is because the Van Stone has a thicker ring height.

COMPRESSED AIR WARNING

The products in this catalog are only intended for use in transferring or storing chemically compatible pressurized liquids. **Do not test or use products in this catalog with compressed air or other gases.** Doing so is dangerous and could cause injury or great bodily harm should a system fail under compressed air. Only use products that are specifically designed for compressed air/gas service. Call Colonial technical service for more information.

FYI

Never thread metal male threads into plastic female threads. Only thread plastic male threads into metal female threads.

Extra care should be taken when transitions are made between metals and thermoplastics. This is especially true if the system is going to experience moderate fluctuations in temperature. Since metals and plastics expand and contract at different rates, it is best to utilize a flanged or metal-to-plastic union transition. Threaded transitions between metal and plastic will leak if the system is subjected to moderate swings in temperature.

TRANSITIONS (THERMOPLASTIC TO METAL)

Thermoplastic (PVC) schedule 40 and schedule 80 fittings can be adapted to metal piping by four different methods.

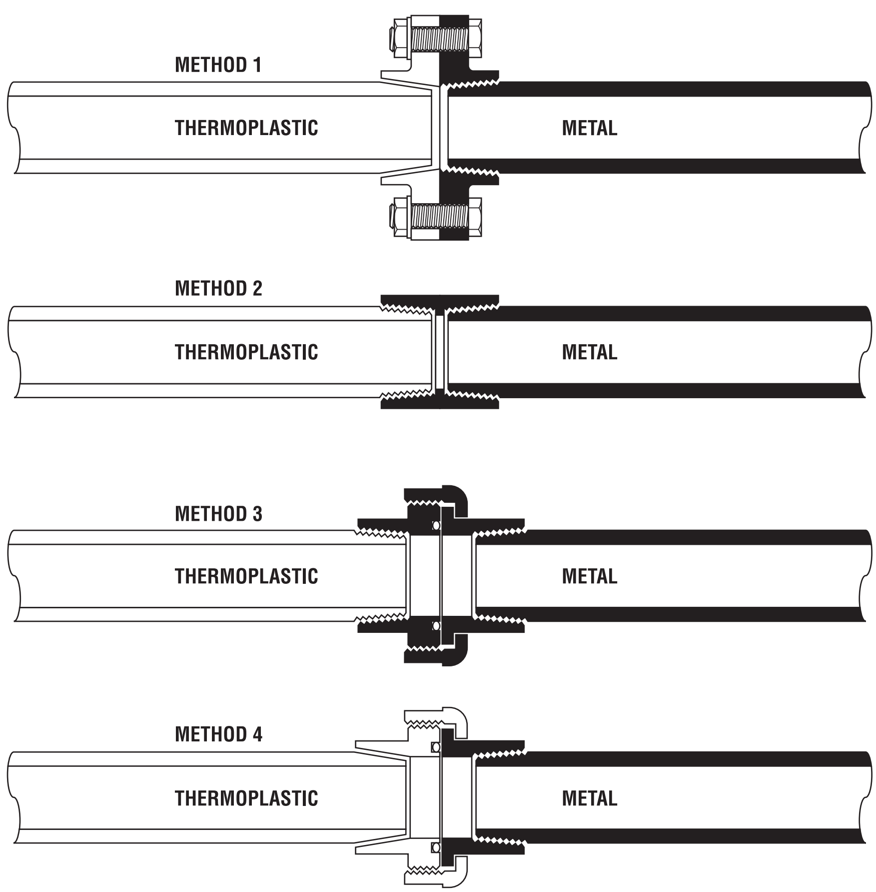
Method 1:
Install thermoplastic cemented or threaded flange (optional) on end of plastic pipe and a threaded metal flange on end of threaded metal pipe. Using the proper elastometric gasket, complete the flanged coupling by following the instructions as outlined in the flanging section.

Method 2:
Install a male thread thermoplastic pipe into the female thread metal coupling, adapter or fitting using Teflon® tape or approved thread sealant and carefully follow instructions for tightening as shown in the Threaded Fittings section. *It is not recommended that male metal threaded fittings or pipe be installed in female thermoplastic fittings.*

Method 3:
Install male thread thermoplastic pipe into a female thread metal union using Teflon tape or approved thread sealant and carefully follow instructions for tightening in the Threaded Fittings section. Install male thread metal pipe into the other half of the metal union and complete union assembly.

Method 4 (Highly Recommended):
Solvent weld thermoplastic pipe into the socket of a thermoplastic union. Use the appropriate sized metal FPT end* on the opposite side to install male thread metal pipe. Complete union assembly.

* Sold separately and featured in this catalog on page 107 Sch 40 PVC, page 123 Sch 80 PVC and page 141 Sch 80 CPVC.



ANCHORS, HANGERS AND GUIDES

Plastic piping must be supported to prevent bending stress and sagging as well as to restrain sections to isolate thermal expansion and contraction forces.

Anchors restrain all axial and transverse movement. Guides and hangers allow for axial movement while restricting transverse movement. All anchors and guides should be engineered to provide function without point loading.

Conventional methods such as roller type devices, clamps, slings and stanchions are acceptable if they are modified for greater bearing area. Protective sleeves or a medium gauge metal sheet between the pipe and the hanger are acceptable. Remove all sharp edges in contact with the plastic. Pipe movement (thermal or mechanical) across any hard surface must be protected by support and/or padding.

Horizontal pipe support spacing recommendations given in Table 19 are based on an acceptable sag of 0.01 inches or less between supports when the pipe is filled with water. If the pipe carries heavier fluids or insulation, then more supports are needed. When support spacing is less than 2 feet apart, then continuous support should be considered such as angle or channel iron, light gauge steel tube, or existing steel work. All valves and other points of weight concentration such as tees and flanges should have independent support beyond the above criteria.

Longer, vertical pipe runs must be anchored or restrained to keep its weight from bending attached pipe. Riser clamps placed under a coupling or fitting should suffice. Other guide clamps (preferably on springs at intervals) can be used to dampen lateral motion.

When pipe clamps or anchors are used they should not force the piping into a position. A piping system should be assembled with temporary supports before final clamping.

Table 19: Recommended Support Spacing (ft) Sch 40 PVC

Pipe Size (in)	Temperature (°F)					
	20	60	80	100	120	140
1/2	5	4-1/2	4-1/2	4	2-1/2	2-1/2
3/4	5-1/2	5	4-1/2	4	2-1/2	2-1/2
1	6	5-1/2	5	4-1/2	3	2-1/2
1-1/4	6	5-1/2	5-1/2	5	3	3
1-1/2	6-1/2	6	5-1/2	5	3-1/2	3
2	6-1/2	6	5-1/2	5	3-1/2	3
2-1/2	7-1/2	7	6-1/2	6	4	3-1/2
3	8	7	7	6	4	3-1/2
4	8-1/2	7-1/2	7	6-1/2	4-1/2	4
6	9-1/2	8-1/2	8	7-1/2	5	4-1/2
8	10	9	8-1/2	8	5	4-1/2
10	11	10	9	8-1/2	5-1/2	5
12	12	11-1/2	10-1/2	9-1/2	6-1/2	5-1/2

Table 20: Recommended Support Spacing (ft) Sch 80 PVC

Pipe Size (in)	Temperature (°F)					
	20	60	80	100	120	140
1/4	4-1/2	4	4	3-1/2	2-1/2	2
3/8	5	4-1/2	4-1/2	4	2-1/2	2-1/2
1/2	5-1/2	5	4-1/2	4-1/2	3	2-1/2
3/4	6	5-1/2	5	4-1/2	3	2-1/2
1	6-1/2	6	5-1/2	5	3-1/2	3
1-1/4	7	6	6	5-1/2	3-1/2	3
1-1/2	7	6-1/2	6	5-1/2	3-1/2	3-1/2
2	7-1/2	7	6-1/2	6	4	3-1/2
2-1/2	8-1/2	7-1/2	7-1/2	6-1/2	4-1/2	4
3	9	8	7-1/2	7	4-1/2	4
4	10	9	8-1/2	7-1/2	5	4-1/2
6	11	10	9-1/2	9	6	5
8	12-1/2	11	10-1/2	9-1/2	6-1/2	5-1/2
10	12	12	11	10	7	6
12	12	12	11	10	7	6

Table 21: Recommended Support Spacing (ft) Sch 80 CPVC

Pipe Size (in)	Temperature (°F)						
	80	100	1200	140	160	180	200
1/4	4	4	3-1/2	3	3	2-1/2	2
1/2	4-1/2	4-1/2	4	4	3-1/2	3	2-1/2
3/4	5-1/2	5	4-1/2	4	3-1/2	3	2-1/2
1	6	5-1/2	5	4-1/2	4	3-1/2	3
1-1/4	6	5-1/2	5-1/2	5	4-1/2	3-1/2	3
1-1/2	6-1/2	6	5-1/2	5	4-1/2	4	3-1/2
2	7	6-1/2	6	5-1/2	5	4	3-1/2
2-1/2	8	7-1/2	7	6	5-1/2	4-1/2	4
3	8-1/2	8	7-1/2	7	6-1/2	5	4
4	9	8-1/2	8	7	6-1/2	5-1/2	4-1/2
6	9-1/2	9	8-1/2	7-1/2	6-1/2	5-1/2	4-1/2

FREQUENTLY ASKED QUESTIONS REGARDING PLASTIC PRESSURE FITTINGS

Q: Flow, knit, weld, and mold parting lines—what are they exactly?

A: From time to time we receive inquiries about plastic pipe fittings. In particular, many people are concerned with what appears to them to be a hairline crack. This "apparent" crack is actually an artifact of the molding process. It is commonly referred to as a "flow line," "knit line" or "weld line."

This line is formed during the injection process by the hot plastic flowing around the cores of the mold and recombining on the opposite side. For this reason the "flow line" appears on both the inside and outside of the fitting. A fitting that displays this line is not defective. All fittings, regardless of manufacturer, have knit lines.

The "flow line" should not be confused with the "mold parting line." This type of line is formed by the location of where the two halves of the injection mold separate. The mold parting line is found only on the outside of the fitting. If the fitting were cut along the "mold parting line," it would separate the fitting into two halves.

Q: It is understood that all producers of PVC and CPVC pressure fittings manufacture to meet the requirements of applicable ASTM standards. Can you explain more about ASTM standards and what aspects of a fitting they cover?

A: ASTM (American Society for Testing and Materials) publishes consensus standards for fittings. These standards include items such as socket and thread dimensions, minimum burst strength and marking requirements.

Q: What is minimum burst strength?

A: Minimum burst strength is the minimum internal hydrostatic pressure that the fittings must withstand prior to breaking. A fitting specimen is placed in a special burst-testing machine and then subjected to ever-increasing pressures until the fitting breaks. The minimum burst pressure must be exceeded during the period of between 60 and 70 seconds and the fitting must survive, intact to pass this test.

Q: Assuming that a fitting passes the ASTM minimum burst strength test, how are standards set for socket depth and what effect does this have on the fittings?

A: ASTM minimum requirements for socket depth are mathematically calculated to provide assurance that the pipe and fitting will not pull apart when properly cemented and cured. In fact, a properly cemented and cured fitting should never pull apart.

Q: How can this be so? I've seen cases where the pipe pulled out of the fitting socket.

A: When this happens, it is either from improper cementing technique or from too short a cure time.

Q: Then just how strong is a properly solvent cemented connection?

A: Very strong! A properly cemented and cured solvent welded connection can withstand twice the minimum burst pressure for a given pipe size. This means that the pull-out strength of a solvent connection to a properly cemented and cured 2" Sch 40 PVC fitting could withstand a pressure of 1,780 psi. To put this another way:

- maximum pressure for 2" schedule 40 pipe is 280 psi,
- the minimum burst pressure for this same pipe is 890 psi,
- and the pressure required to pull pipe out of a socket is 1,780 psi!

Q: I see now why they say if a pipe pulls out of a socket, something major went wrong during assembly or there was not enough cure time prior to applying pressure. Still, does Colonial Engineering just meet the minimum required socket depths?

A: Colonial Engineering goes even further than the minimum required. For schedule 40 fittings, where part weights and lengths are crucial to our customers, we increase the socket depth by 10 to 20%, depending on the geometry of the fitting. Schedule 80 fittings are higher performance fittings, therefore we increase the socket depth by 15 to 30%. The increase in socket depth reduces the shear stress of the pipe trying to pull out of the socket. Therefore it is more difficult for the solvent cemented pipe to pull out of the socket during operation.

Q: Can socket lengths be too long?

A: Yes! If the socket length is made too long it can make it difficult to fully insert the pipe to the bottom of the socket. Longer sockets have more surface area, so there is more resistance to pipe insertion due to surface friction. This is especially true when working with large diameter piping. Also, problems can occur for installers setting up a manifold system if sockets are made too long. Colonial has endeavored to design socket lengths that afford extra resistance to shear stress, without creating these problems.

Q: How about threaded fittings? To what standards are the threads made?

A: ASTM standard D 1498. This standard sets the requirements for threads. Plastic threaded fittings that are made with an NPT (National Pipe Taper) thread are the same as a metal thread in every way except the tolerance on the number of turns plus or minus. Metal NPT threads have a tolerance of plus or minus 1 turn and plastic NPT threads have a plus or minus 1-1/2 turns.

Q: Since metal and plastic threads are the same, does this mean I can put a metal male threaded nipple into a plastic female adapter? I have done this in the past, but sometimes the plastic female adapter breaks. How can I transition from metal to plastic without this type of failure occurring?

A: First, you should never put a metal male threaded fitting into a plastic female adapter. It is, however, proper to insert a plastic male thread into a metal female thread. For more information on this topic, please see page 32.

Q: Does Colonial take any additional steps to increase the reliability of its fittings?

A: Colonial takes an extra step by conducting cyclical fatigue pressure testing. This testing places a fitting under repetitive cycles of pressure. In the normal course of operation, piping systems often experience changes in pressure. These pressure variations can be small or large depending on the type or operating conditions of a system. Due to fitting geometry (fittings provide changes in direction) they are more susceptible to cyclical fatigue. 90° Elbows and Tees are most susceptible and are held to stringent, self-imposed testing standards.

Q: Is the cyclic fatigue testing being done at Colonial Engineering an ASTM requirement?

A: Although it is not a requirement, Colonial Engineering has been a leader in cyclic testing. We have been performing cyclic testing for over 15 years. The data gained from this work has significantly improved Colonial's product lines. By performing cyclic fatigue testing, Colonial Engineering goes well beyond the minimum requirements of ASTM to produce reliable fittings for your piping systems.