

Installation Procedures for ABS, PVC and CPVC Piping Systems

The following information contains suggested installation and testing procedures. These instructions, however, do not encompass all of the requirements for the design or installation of a piping system.

- Systems should be installed in a good and workmanlike manner consistent with normal industry standards and in conformance with all applicable plumbing, fire and building code requirements.
- Pipe and fitting systems should be used for their intended purpose as defined by local plumbing and building codes and the applicable ASTM standard.
- Follow manufacturers' instructions for all products.

PVC, CPVC and ABS piping systems may be joined by solvent cementing, with threaded connections, flanges or roll grooving. Detail on each of these joining systems is provided within the following pages. When applicable, Charlotte Pipe recommends socket (solvent cement) joining for PVC, CPVC and ABS piping systems.

Cutting, Joint Preparation and Solvent Cement

The tools, cleaner, primer, solvent cement and techniques required to properly join plastic piping systems are dependant upon application, pipe diameter and weather conditions. Charlotte Pipe and Foundry recommends that installers be trained and pass the ASME B 31.3 Bonder Qualification Test.

Please see the Special Considerations section of this manual for additional information.

This installation manual provides direction for the installation of the following piping systems:

- ½" – 2" FlowGuard Gold® and ReUze® CTS CPVC pipe and fitting systems with one step solvent cement.
- ½" – 4" Iron Pipe Size ABS, PVC and CPVC pipe and fitting systems with two step solvent cement.
- 6" Iron Pipe Size and larger ABS, PVC and CPVC pipe and fitting systems with two step solvent cement.

WARNING

To reduce the risk of death or serious injury from an explosion, collapse or projectile hazard and to reduce the risk of property damage from a system failure:

- Always follow the warnings and procedures provided in this manual.
- Only use PVC/ABS/CPVC pipe and fitting for the conveyance of fluids as defined within the applicable ASTM standards.
- Never use PVC/ABS/CPVC pipe and fittings for the conveyance of gasses.
- Never use PVC/ABS/CPVC pipe or fittings in structural application or in any load-bearing applications.
- Never strike the pipe or fittings or drive them into the ground or into any other hard substance.

WARNING

Failure to follow **safety precautions** may result in misapplication or improper installation and testing which can cause severe personal injury and / or property damage.

WARNING

Do not use for SPUD GUNS, FLAMETHROWERS, or COMPRESSED AIR GUNS. May result in property damage, injury or death. Use only for fluid handling / plumbing applications.

NOTICE

- Using an external heat source to bend PVC, CPVC, or ABS may result in structural damage to pipe and fittings.
- Always make changes in direction with fittings.

FlowGuard Gold® and ReUze® CTS Installation Procedures

1. Cut Pipe

- Cut pipe square with the axis. All joints are sealed at the base of the fitting hub. An angled cut may result in joint failure.
- Acceptable tools include ratchet type pipe cutter, miter saw or wheel type pipe cutter. Wheel type pipe cutters must employ a blade designed to cut plastic pipe. Ratchet cutters should be sharpened regularly.
- If any indication of damage or cracking is evident at the tube end, cut off at least 2" of pipe beyond any visible cracks.



2. Remove Burrs and Bevel

- Remove all pipe burrs from inside and outside diameter of pipe with a knife edge, file or de-burring tool.
- Chamfer (bevel) the end of the pipe 10° - 15°.



3. Clean and Dry Pipe and Fittings

- Remove surface dirt, grease or moisture with a clean dry cloth.



4. Dry Fit

- With light pressure, pipe should go one half to two thirds of the way into the fitting hub. Pipe and fittings that are too tight or too loose should not be used.



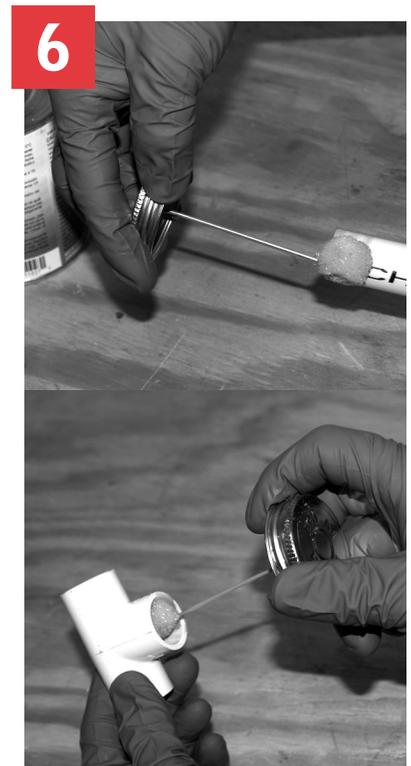
5. Applicator

- Use an applicator that is one half the size of the pipe's diameter.
- Too large an applicator will force excess primer or cement into the inside of the fitting. Too small an applicator will not apply sufficient cement.



6. Coat Surface with Cement

- Stir or shake the cement prior to use.
- Apply a full even layer of cement to the pipe surface to a point 1/2" beyond the hub depth. Aggressively work the cement into the surface.
- Without re-dipping the applicator in the cement, apply a thin layer of cement to the fitting socket aggressively working it into the surface.



INSTALLATION PROCEDURES

- Do not allow cement to puddle or accumulate inside the system.
- Solvent cement should conform to ASTM F 493 as shown in the accompanying table. All purpose cement is not recommended.
- Primer is not required for FlowGuard Gold® one-step cement, but may be used. Check local code requirements.

7. Join Pipe and Fittings



- Assemble pipe and fittings quickly while cement is fluid. If cement has hardened, cut pipe, dispose of fitting and start over.
- Insert pipe into fitting hub giving a quarter turn ensuring an even distribution of cement within the joint.
- Once the pipe contacts the socket bottom hold pipe and fitting together until the pipe does not back out.
- Align all piping system components properly without strain. Do not bend or pull pipe into position after being solvent welded.
- See table for recommended set and cure times.

- Remove excess cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter. If voids appear sufficient cement may not have been applied and joint failure may result.



WARNING

Primers and cements are extremely flammable and may be explosive. Do not store or use near open flame or elevated temperatures, which may result in injury or death.

- Solvent fumes created during the joining process are heavier than air and may be trapped in newly installed piping systems.
- Ignition of the solvent vapors caused by spark or flame may result in injury or death from explosion or fire.
- Read and obey all manufacturers' warnings and any instructions pertaining to primers and cements.
- Provide adequate ventilation to reduce fire hazard and to minimize inhalation of solvent vapors when working with cements, primers and new piping systems.

ABS, PVC and CPVC Iron Pipe Size Installation Procedures

1/2" – 4" Iron Pipe Size ABS, PVC and CPVC Pipe and Fitting Systems

1. Cut Pipe

- Cut pipe square with the axis. All joints are sealed at the base of the fitting hub. An angled cut may result in joint failure.
- Acceptable tools include ratchet type pipe cutter, miter saw, reciprocating saw, mechanical cut off saw with carbide tipped blade or wheel type pipe cutter. Wheel type pipe cutters must employ a blade designed to cut plastic pipe. Ratchet cutters should be sharpened regularly.
- If any indication of damage or cracking is evident at the pipe end, cut off at least 2" of pipe beyond any visible cracks.



2. Remove Burrs and Bevel

- Remove all pipe burrs from inside and outside diameter of pipe with a knife edge, file or de-burring tool.
- Chamfer (bevel) the end of the pipe 10° - 15°.



3. Clean and Dry Pipe and Fittings

- Remove surface dirt, grease or moisture with a clean dry cloth.



4. Dry Fit

- With light pressure, pipe should go one half to two thirds of the way into the fitting hub. Pipe and fittings that are too tight or too loose should not be used.



5. Applicator

- Use an applicator that is one half the size of the pipe's diameter. Daubers, natural bristle brushes or swabs are recommended. Rollers are not recommended.
- Too large an applicator will force excess primer or cement into the inside of the fitting. Too small an applicator will not apply sufficient cement.

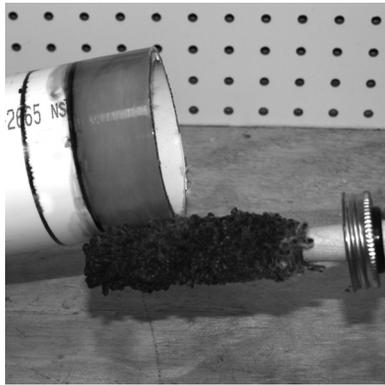
6. Coat Surface with Primer

- Apply primer to the fitting socket aggressively working it into the surface.



INSTALLATION PROCEDURES

- Apply primer to the pipe surface to a point $\frac{1}{2}$ " beyond the hub depth. Aggressively work the primer into the surface.



- Apply a second coat of primer to the fitting socket aggressively working it into the surface.



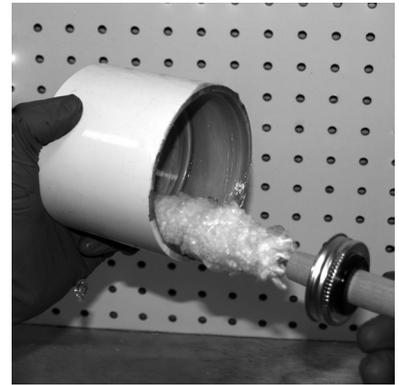
- More applications of primer may be required on hard surfaces or cold weather conditions.
- Once the surface is primed remove all puddles of excess primer from the fitting socket.
- Primer should conform to ASTM F 656.
- The use of primer for ABS is not recommended. Check local code requirements.

7. Coat Surface with Cement



- Cement must be applied while primer is wet.
- Stir or shake the cement prior to use.
- Apply a full even layer of cement to the pipe surface to a point $\frac{1}{2}$ " beyond the hub depth. Aggressively work the cement into the surface.

- Without re-dipping the applicator in the cement, apply a medium layer of cement to the fitting socket aggressively working it into the surface. On bell end pipe do not coat beyond the socket depth.



- Apply a second full coat of cement to the pipe surface aggressively working it in.



- Do not allow cement to puddle or accumulate inside the system.
- Solvent cement should conform to the appropriate ASTM standard for the piping system as shown in the accompanying table. All purpose cement is not recommended

8. Join Pipe and Fittings



- Assemble pipe and fittings quickly while cement is fluid. If cement has hardened, cut pipe, dispose of fitting and start over.
- Insert pipe into the fitting hub giving a quarter turn as the pipe is being inserted, ensuring an even distribution of the cement within the joint. Do not quarter turn the pipe after contact with socket bottom.
- Once the pipe contacts the socket bottom hold pipe and fitting together until the pipe does not back out.
- See table for recommended set and cure times.

- Remove excess cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter. If voids appear sufficient cement may not have been applied and joint failure may result.



- Align all piping system components properly without strain. Do not bend or pull pipe into position after being solvent welded.

WARNING

Primers and cements are extremely flammable and may be explosive. Do not store or use near open flame or elevated temperatures, which may result in injury or death.

- Solvent fumes created during the joining process are heavier than air and may be trapped in newly installed piping systems.
- Ignition of the solvent vapors caused by spark or flame may result in injury or death from explosion or fire.
- Read and obey all manufacturers' warnings and any instructions pertaining to primers and cements.
- Provide adequate ventilation to reduce fire hazard and to minimize inhalation of solvent vapors when working with cements, primers and new piping systems.

ABS, PVC and CPVC Iron Pipe Size Installation Procedures

6" and Larger Iron Pipe Size ABS, PVC and CPVC Pipe and Fitting Systems

Joining larger diameter piping systems, particularly for pressure applications, requires a higher degree of skill. Proper installation technique is critical. Close attention to the steps below will help professional mechanics to complete successful installations.

1. Cut Pipe

- Cut pipe square with the axis. All joints are sealed at the base of the fitting hub. An angled cut may result in joint failure.
- Acceptable tools include reciprocating saw, mechanical cut off saw with carbide tipped blade or other appropriate tool.
- If any indication of damage or cracking is evident at the (tube / pipe) end, cut off at least 2" of pipe beyond any visible cracks.



2. Remove Burrs and Bevel

- Remove all pipe burrs from inside and outside diameter of pipe with a de-burring tool.
- Chamfer (bevel) the end of the pipe 10° - 15°. Powered and manual chamfering tools are available.



3. Clean and Dry Pipe and Fittings

- Remove surface dirt, grease or moisture with a clean dry cloth.



4. Mark Insertion Depth

- Measure the fitting hub depth. Using a pipe wrap as a straight edge mark the insertion depth plus 2" in a heavy continuous line around the circumference of the pipe.



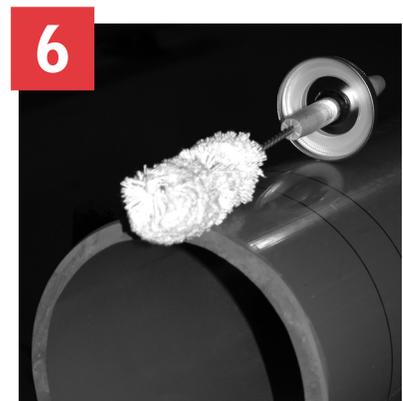
5. Dry Fit

- With light pressure, pipe should go one half to two thirds of the way into the fitting hub. Pipe and fittings that are too tight or too loose should not be used.



6. Applicator

- Use an applicator that is one half the size of the pipe's diameter. Use of an appropriately sized applicator will ensure that adequate cement is applied. Natural bristle brushes or swabs are recommended. Rollers are not recommended.
- Too small an applicator will not apply sufficient cement.



7. Crew Size

- Working rapidly, especially in adverse weather conditions, will improve installations. For 6" to 8" diameters a crew size of 2 to 3 mechanics is required. For 10" pipe diameters and larger a crew of 3 to 4 mechanics may be required.

8. Coat Surface with Primer

- Apply primer to the fitting socket aggressively working it into the surface.



- Apply primer to the pipe surface to a point 1/2" beyond the hub depth. Aggressively work the primer into the surface.



- Apply a second coat of primer to the fitting socket aggressively working it into the surface.
- More applications of primer may be required on hard surfaces or cold weather conditions.



- NOTICE:** Pipe diameters 6" and larger must be installed using IPS P-70 or Oatey Industrial Grade primers.

WARNING

Primers and cements are extremely flammable and may be explosive. Do not store or use near open flame or elevated temperatures, which may result in injury or death.

- Solvent fumes created during the joining process are heavier than air and may be trapped in newly installed piping systems.
- Ignition of the solvent vapors caused by spark or flame may result in injury or death from explosion or fire.
- Read and obey all manufacturers' warnings and any instructions pertaining to primers and cements.
- Provide adequate ventilation to reduce fire hazard and to minimize inhalation of solvent vapors when working with cements, primers and new piping systems.

- Once the surface is primed remove all puddles of excess primer from the fitting socket.
- The use of primer for ABS is not recommended. Check local code requirements.

9. Coat Surface with Cement

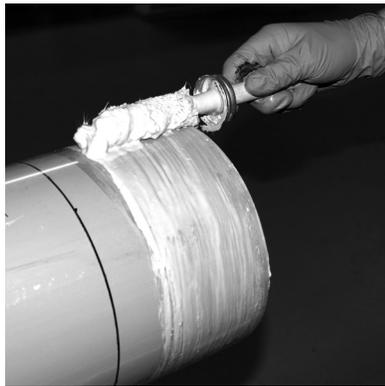
- Cement must be applied while primer is wet. It is ideal if one mechanic applies the primer while a second immediately applies the cement.
- Stir or shake the cement prior to use.
- Apply a full even layer of cement to the pipe surface to a point 1/2" beyond the hub depth. Aggressively work the cement into the surface.



- Apply a medium layer of cement to the fitting socket aggressively working it into the surface. On bell end pipe do not coat beyond the socket depth.



- Apply a second full coat of cement to the pipe surface aggressively working it in.



- Do not allow cement to puddle or accumulate inside the system.

- Solvent cement should conform

to the appropriate ASTM standard for the piping system as shown in the accompanying table. Heavy bodied cement is recommended. All purpose cement is not recommended

- **NOTICE:** CPVC Schedule 80 systems must be installed using IPS 714 or Oatey CPVC Heavy Duty Orange solvent cements.

10. Join Pipe and Fittings

- Assemble pipe and fittings quickly while cement is fluid. If cement has hardened, cut pipe, dispose of fitting and start over.

- It is very important that the pipe is fully inserted to the fitting stop at the bottom of the fitting. Large diameter pipe is heavy and can develop significant resistance during insertion. The use of a pulling tool designed for plastic piping systems is recommended.

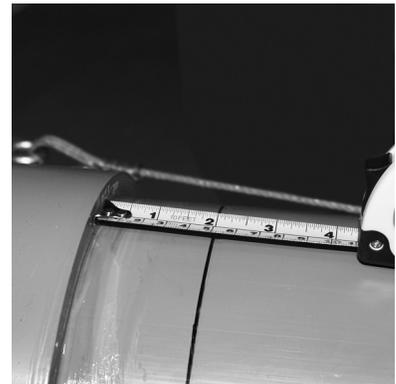


CAUTION

Failure to follow proper installation practices, procedures, or techniques may result in personal injury, system failure or property damage.

- Use a solvent cement / primer applicator that is 1/2 the size of the pipe's diameter. Too large an applicator will result in excess cement inside the fitting. Too small an applicator will not apply sufficient cement.
- Cut pipe square.
- Do not use dull or broken cutting tool blades when cutting pipe.
- Do not test until recommended cure times are met.
- Align all piping system components properly without strain. Do not bend or pull pipe into position after being solvent welded.

- Measure to verify that the pipe has been inserted to within 2" of the insertion line.

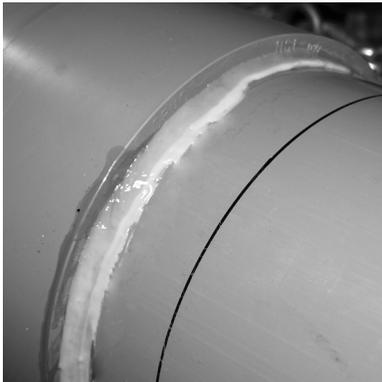


- To ensure joint integrity, once insertion is complete, the pulling tool can be used to hold the joint in place during set time and also to ensure that the pipe does not back out.



- See table for recommended set and cure times.

- Remove excess cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter. If voids appear sufficient, cement may not have been applied and joint failure may result.
- Align all piping system components properly without strain. Do not bend or pull pipe into position after being solvent welded.



WARNING

Primers and cements are extremely flammable and may be explosive. Do not store or use near open flame or elevated temperatures, which may result in injury or death.

- Solvent fumes created during the joining process are heavier than air and may be trapped in newly installed piping systems.
- Ignition of the solvent vapors caused by spark or flame may result in injury or death from explosion or fire.
- Read and obey all manufacturers' warnings and any instructions pertaining to primers and cements.
- Provide adequate ventilation to reduce fire hazard and to minimize inhalation of solvent vapors when working with cements, primers and new piping systems.

Solvent Cements

Pipe and Fitting System	Diameter (in.)	Solvent Cement Standard	Cement Color (common usage, check local code)	Description	Primer (common usage, check local code)
ABS DWV	1½ - 6	ASTM D 2235	Black	Regular or Medium-Bodied	Not Recommended
ABS Plus® Foam Core Pipe	1½ - 4	ASTM D 2235	Black	Regular or Medium-Bodied	Not Recommended
FlowGuard Gold® and ReUze® CTS CPVC	½ - 2	ASTM F 493	Yellow	Regular-Bodied	Optional
CPVC Sch. 80	½ - 2	ASTM F 493	IPS 714 or Oatey CPVC Heavy Duty Orange	Heavy-Bodied	IPS P-70 or Oatey Industrial Grade
CPVC Sch. 80	2½ - 8	ASTM F 493	IPS 714 or Oatey CPVC Heavy Duty Orange	Heavy-Bodied	IPS P-70 or Oatey Industrial Grade
CPVC Sch. 40 ChemDrain	1¼ - 8	ASTM F 493	ChemDrain Mustard Yellow (Required)	Heavy-Bodied	6" and larger: IPS P-70 or Oatey Industrial Grade required
PVC DWV or Sch. 40 Pressure	½ - 4	ASTM D 2564	Clear	Regular or Medium-Bodied	Required ASTM F 656
PVC DWV or Sch. 40 Pressure	6 - 16	ASTM D 2564	Clear or Grey	Medium or Heavy-Bodied	Required ASTM F 656
PVC Sch. 80	¼ - 2	ASTM D 2564	Grey	Medium or Heavy-Bodied	Required ASTM F 656
PVC Sch. 80	2½ - 16	ASTM D 2564	Grey	Heavy-Bodied	IPS P-70 or Oatey Industrial Grade

NOTICE: Aerosol or spray-on type primers/solvent cements are not recommended. The practice of aggressively scouring the pipe and fittings with both primer and solvent cement is an integral part of the joining process. Not working the primer or solvent cement into the pipe or fitting could cause potential system failure or property damage.

WARNING

Primers and cements are extremely flammable and may be explosive. Do not store or use near open flame or elevated temperatures, which may result in injury or death.

- Solvent fumes created during the joining process are heavier than air and may be trapped in newly installed piping systems.
- Ignition of the solvent vapors caused by spark or flame may result in injury or death from explosion or fire.
- Read and obey all manufacturers' warnings and any instructions pertaining to primers and cements.
- Provide adequate ventilation to reduce fire hazard and to minimize inhalation of solvent vapors when working with cements, primers and new piping systems.

Applicator Types

Nominal Pipe Size (in.)	Applicator Type		
	Dauber	Brush Width (in.)	Swab Length (in.)
¼	A	½	NR
⅜	A	½	NR
½	A	½	NR
¾	A	1	NR
1	A	1	NR
1¼	A	1	NR
1½	A	1 - 1½	NR
2	A	1 - 1½	NR
2½	NR	1½ - 2	NR
3	NR	1½ - 2½	NR
4	NR	2 - 3	3
6	NR	3 - 5	3
8	NR	4 - 6	7
10	NR	6 - 8	7
12	NR	6 - 8	7
14	NR	7 - 8	7
16	NR	8+	8

A = Acceptable

NR = Not Recommended

NOTICE: Rollers are not recommended.

Joint Curing

The joint should not be disturbed until it has initially set. The chart below shows the recommended initial set and cure times for ABS, PVC and CPVC in iron pipe size diameters as well as for FlowGuard Gold® and ReUze® CTS CPVC.

Recommended Initial Set Times

Temperature Range	Diameter ½" to 1¼"	Diameter 1½" to 3"	Diameter 4" to 8"	Diameter 10" to 16"
60° - 100° F	15 min	30 min	1 hr	2 hr
40° - 60° F	1 hr	2 hr	4 hr	8 hr
0° - 40° F	3 hr	6 hr	12 hr	24 hr

NOTICE

A joint should not be pressure tested until it has cured. The exact curing time varies with temperature, humidity, and pipe size. The presence of hot water extends the cure time required for pressure testing. Pressurization prior to joint curing may result in system failure.

Recommended Curing Time Before Pressure Testing

RELATIVE HUMIDITY 60% or Less*	CURE TIME Diameter ½" to 1¼"		CURE TIME Diameter 1½" to 3"		CURE TIME Diameter 4" to 8"		CURE TIME Diameter 10" to 16"
Temperature Range During Assembly and Cure Periods	Up to 180 psi	Above 180 to 370 psi	Up to 180 psi	Above 180 to 315 psi	Up to 180 psi	Above 180 to 315 psi	Up to 100 psi
60° - 100° F	1 hr	6 hr	2 hr	12 hr	6 hr	24 hr	24 hr
40° - 60° F	2 hr	12 hr	4 hr	24 hr	12 hr	48 hr	48 hr
0° - 40° F	8 hr	48 hr	16 hr	96 hr	48 hr	8 days	8 days

*For relative humidity above 60%, allow 50% more cure time.

The above data are based on laboratory tests and are intended as guidelines.

For more specific information, contact should be made with the cement manufacturer.

*Average number of joints per Quart for Cement and Primer (Source: IPS Weld-on)

Pipe Diameter	½"	¾"	1"	1½"	2"	3"	4"	6"	8"	10"	12"	15"	18"
Number of Joints	300	200	125	90	60	40	30	10	5	2 to 3	1 to 2	¾	½

For Primer: double the number of joints shown for cement.

* These figures are estimates based on IPS Weld-on laboratory tests.

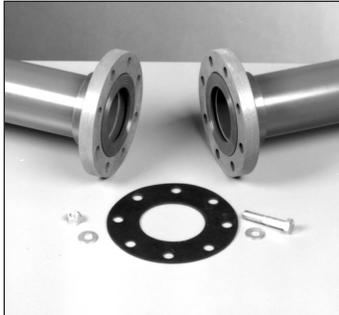
Due to many variables in the field, these figures should be used as a general guide only.

Flanges

For systems where dismantling is required, flanging is a convenient joining method. It is also an easy way to join plastic and metallic systems.

Installation

- Join the flange to the pipe using the procedures shown in the solvent cementing or threading sections. Due to the tensile stresses placed on the solvent cement joint for flange connections, double the recommended curing time before joint assembly and pressure testing.
- Use a full faced elastomeric gasket which is resistant to the chemicals being conveyed in the piping system. A gasket $\frac{1}{8}$ " thick with a Durometer, scale "A", hardness of 55 -80 is normally satisfactory.
- Align the flanges and gasket by inserting all of the bolts through the mating flange bolt holes. Be sure to use properly sized flat washers under all bolt heads and nuts.
- Sequentially tighten the bolts using a torque wrench, corresponding to the patterns shown below in increments of 10 ft-lbs at a time up to the recommended torque. New bolts and nuts should be used for proper torque.
- Tighten flanges only to maximum recommended torque limits; do not tighten bolts in such a manner as to cause the flange ring to bend or be under stress. Connect to full face flanges or valves that conform to ANSI B16.5 150 pound dimensions and that provide full support under the entire flange face.



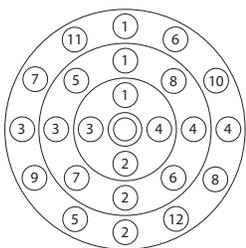
- Use a torque wrench to tighten the bolts to the torque values shown below.
- Use of thread lubricant will ensure proper torque. Confirm that the thread lubricant is chemically compatible with pipe and fittings.
- When installing flanges in a buried application where settling could occur, the flange must be supported to maintain proper alignment in service.

Recommended Torque

Pipe Size In Inches	No. Bolt Holes	Bolt Diameter	Recommended Torque ft-lbs
$\frac{1}{2}$	4	$\frac{1}{2}$	10 - 15
$\frac{3}{4}$	4	$\frac{1}{2}$	10 - 15
1	4	$\frac{1}{2}$	10 - 15
$1\frac{1}{4}$	4	$\frac{1}{2}$	10 - 15
$1\frac{1}{2}$	4	$\frac{1}{2}$	10 - 15
2	4	$\frac{5}{8}$	20 - 30
$2\frac{1}{2}$	4	$\frac{5}{8}$	20 - 30
3	4	$\frac{5}{8}$	20 - 30
4	8	$\frac{5}{8}$	20 - 30
6	8	$\frac{3}{4}$	33 - 50
8	8	$\frac{3}{4}$	33 - 50
10	12	$\frac{7}{8}$	53 - 65
12	12	$\frac{7}{8}$	53 - 75

Note: Flanges meet the bolt-pattern requirements of ANSI / ASME B 16.5

Flange Tightening Sequence



WARNING

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

AIR/GAS

- NEVER test with or transport/store compressed air or gas in PVC / ABS / CPVC pipe or fittings.
- NEVER test PVC / ABS / CPVC pipe or fittings with compressed air or gas, or air over water boosters.
- ONLY use PVC / ABS / CPVC pipe or fittings for water or approved chemicals.
- Refer to warnings on PPFA's website and ASTM D 1785.

NOTICE

- Exceeding recommended flange bolt torque may result in component damage, system failure and property damage.
- Use the proper bolt tightening sequence as marked on the flange.
- Make sure the system is in proper alignment.
- Flanges may not be used to draw piping assemblies together.
- Flat washers must be used under every nut and bolt head.
- Connect to full face flanges or valves that conform to ANSI B16.5 150 pound dimensions and that provide full support under the entire flange face.
- Exceeding recommended pressure rating and/or temperature ratings may result in component damage, system failure and property damage.
- Ensure that thread lubricant is chemically compatible with pipe and fittings.
- Piping systems differ in chemical resistance. Pipe or fittings may be damaged by contact with products containing incompatible chemicals resulting in system failure and/or property damage.
- Corrosion resistant bolts, nuts, and flat washers are recommended in chemical applications.

Pressure Rating of PVC and CPVC Flanges at Elevated Temperatures

System Operating Temp. Temperature °F (C)		70 (23)	80 (27)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)	150 (66)	160 (71)	170 (77)	180 (82)	200 (93)
Pressure Rating (psi)	$\frac{1}{2}$ " - 12"	PVC	150	132	113	93	75	60	45	33	NR	NR	NR	NR
		CPVC	150	144	137	123	116	98	75	70	60	48	38	30

NR = Not Recommended

Unions

A union fitting permits easy disconnection of a piping system for replacement or repair in the line. Union fittings consist of three separate parts that when installed properly join two sections of pipe together.

Installing the union threaded piece and union piece socket end should be done in accordance with the solvent cementing instructions provided in this manual. Care should be taken so that solvent cement does not come into contact with the union threads or the union face. **Note:** It is important to remember to place the union shoulder piece on the pipe prior to solvent cementing to the pipe. Thread or solvent cement the union threaded piece to the pipe. The joint should not be disturbed until it has initially set. Once the joints have properly cured, ensure that the two mating pieces are flush to one another prior to tightening the union ring. The ring should not draw piping systems together or correct improper alignment of the system. The ring should be hand tightened or tightened with a strap wrench only.

NOTICE

Do not exceed the maximum working pressure of any system components including pipe, fittings, valves, molded or cut threads, unions, mechanical coupling or flanges.

- The pressure rating of all components must be reduced at temperatures above 73 degrees F. Refer to de-rating table in this manual.
- Exceeding the maximum working temperature or pressure of the system may result in system failure and property damage.

Pressure Rating for PVC Schedule 80 Unions

Size	Unions	
	Socket Type	Threaded Type
	Max Working Pressure @ 73°F	Max Working Pressure @ 73°F
½"	235 psi	235 psi
¾"	235 psi	235 psi
1"	235 psi	235 psi
1¼"	235 psi	235 psi
1½"	235 psi	235 psi
2"	235 psi	200 psi
3"	235 psi	185 psi

NOTICE

Unions may be damaged by contact with products containing incompatible chemicals resulting in property damage or personal injury.

- Do not use lubricants or thread sealants on the union nuts.
- Never use common wrenches or tools designed for metallic pipe systems. Only use strap wrenches.
- Unions may not be used to draw piping assemblies together.
- Exceeding recommended pressure rating and/or temperature rating may result in component damage, system failure and property damage.

Threaded Joints and Threading of PVC and CPVC Pipe

Only Schedule 80 PVC and Schedule 80 CPVC pipe can be threaded. Schedule 40 or SDR pipe cannot be threaded; molded threaded adapters must be used on those systems.

The pressure rating of molded or cut threads must be derated by an additional 50% beyond the pressure rating for pipe and fittings. See pressure/temperature derating information in this technical manual for systems exposed to operating conditions above 73°F.

NOTICE

Do not exceed the maximum working pressure of any system components including pipe, fittings, valves, molded or cut threads, unions, mechanical coupling or flanges.

- The pressure rating of all components must be reduced at temperatures above 73 degrees F. Refer to de-rating table in this manual.
- Exceeding the maximum working temperature or pressure of the system may result in system failure and property damage.

Maximum Pressure Rating for PVC and CPVC Piping Systems With Threaded Fittings or Threaded Pipe in Pressure Applications

Size	Type	Pressure Rating (PSI) @								
		73 °F	80 °F	90 °F	100 °F	110 °F	120 °F	130 °F	140 °F	150 °F
1/2"	PVC Sch. 40	300	264	225	186	150	120	90	66	NR
	PVC Sch. 80 / CPVC Sch. 80	425	374	319	264	213	170	128	94	NR
3/4"	PVC Sch. 40	240	211	180	149	120	96	72	53	NR
	PVC Sch. 80 / CPVC Sch. 80	345	304	259	214	173	138	104	76	NR
1"	PVC Sch. 40	225	198	169	140	113	90	68	50	NR
	PVC Sch. 80 / CPVC Sch. 80	315	277	236	195	158	126	95	69	NR
1-1/4"	PVC Sch. 40	185	163	139	115	93	74	56	41	NR
	PVC Sch. 80 / CPVC Sch. 80	260	229	195	161	130	104	78	57	NR
1-1/2"	PVC Sch. 40	165	145	124	102	83	66	50	36	NR
	PVC Sch. 80 / CPVC Sch. 80	235	207	176	146	118	94	71	52	NR
2"	PVC Sch. 40	140	123	105	87	70	56	42	31	NR
	PVC Sch. 80 / CPVC Sch. 80	200	176	150	124	100	80	60	44	NR
3"	PVC Sch. 40	130	114	98	81	65	52	39	29	NR
	PVC Sch. 80 / CPVC Sch. 80	185	163	139	115	93	74	56	41	NR
4"	PVC Sch. 40	110	97	83	68	55	44	33	24	NR
	PVC Sch. 80 / CPVC Sch. 80	160	141	120	99	80	64	48	35	NR
6"	PVC Sch. 40	90	79	68	56	45	36	27	20	NR

Note: Threading of PVC Schedule 40 and CPVC Schedule 80 pipe is not recommended.

Threading pipe over 4" in diameter is not recommended.

Please see the Flanges and Unions Section of this manual for maximum working pressure of piping systems incorporating those fittings at elevated temperatures.

Procedure for Cutting Threads in Schedule 80 Pipe

1. Cutting

The pipe must be cut square using a power saw, a miter box, or a plastic pipe cutter. Burrs should be removed using a knife or deburring tool.

2. Threading

Threads can be cut using either hand held or power threading equipment. The cutting dies should be clean, sharp, and in good condition. Special dies for cutting plastic pipe are available and are recommended.

When using a hand threader, the dies should have a 5° to 10° negative front rake. When using a power threader, the dies should have a 5° negative front rake and the die heads should be self-opening. A slight chamfer to lead the dies will speed production. However, the dies should not be driven at high speeds or with heavy pressure.

When using a hand held threader, the pipe should be held in a pipe vise. To prevent crushing or scoring of the pipe, a protective wrap such as emery paper, canvas, rubber, or a light metal sleeve should be used.

Insert a tapered plug into the end of the pipe to be threaded. This plug will provide additional support and prevent distortion of the pipe in the threading area.

It is recommended that a water soluble machine oil, chemically compatible with PVC and CPVC, be used during the threading operation. Also, clearing the cuttings from the die is highly recommended.

Do not over-thread the pipe. Consult the diagram and table showing ASTM F 1498 dimensions for American Standard Taper pipe threads. Periodically check the threads with a ring gauge to ensure that the threads are accurate. The tolerance is $\pm 1\frac{1}{2}$ turns.

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Installation of Threaded Connections

1. Make sure the threads are clean. Charlotte Pipe recommends Teflon* tape as a sealant for threaded connections. Use a good quality Teflon tape which has .4 minimum density, .003" thick, .50% elongation and chemically inert.
2. Wrap the Teflon tape around the entire length of the threads; start with two wraps at the end and wrap all threads overlapping half the width of the tape. Wrap in the direction of the threads on each wind.
3. Maximum wrench-tightness is two turns past finger tight. Do not use common wrenches or tools designed for metallic pipe systems.

NOTICE

Piping systems differ in chemical resistance. Pipe or fittings may be damaged by contact with products containing incompatible chemicals resulting in property damage.

- Verify that paints, thread sealants, lubricants, plasticized PVC products, foam insulations, caulks, leak detectors, insecticides, termiticides, antifreeze solutions, pipe sleeve, firestop materials or other materials are chemically compatible with ABS, PVC or CPVC.
- Do not use edible oils such as Crisco® for lubricant.
- Read and follow chemical manufacturer's literature before using with piping materials.
- Confirm compatibility of pipe marking adhesive tape with the manufacturer of the tape to ensure chemical compatibility with CPVC pipe and fittings.

NOTICE: Charlotte does **not** recommend pipe joint compounds, pastes or lubricants for thermoplastic pipe as the use of an incompatible compound may result in the degradation or failure of the plastic pipe or fittings.

NOTICE

Exceeding recommended torque for threaded connections may result in component damage, system failure and property damage.

The following chart shows the correct amount of tape and torque required to make a properly functioning assembly.

Installation of Brass and CPVC Threaded Fittings			
Pipe Size	Torque Setting		Teflon Tape
	Brass Threaded Fittings	CPVC Threaded Fittings	
½"	14 ft.lbs.	3 to 5 ft.lbs.	½" width
¾"	18 ft.lbs.	4 to 6 ft.lbs.	½" width
1"	24 ft.lbs.	5 to 7 ft.lbs.	½" width
1¼"	30 to 60 ft.lbs.	5 to 7 ft.lbs.	1" width
1½"	23 to 34 ft.lbs.	6 to 8 ft.lbs.	1" width
2"	36 to 50 ft.lbs.	8 to 10 ft.lbs.	1" width

Note: 1 foot pound = 12 inch pounds

Important Information on Threaded Connections

Millions of PVC, ABS and CPVC threaded fittings have been produced over the years. When properly installed these fittings provide excellent service in both pressure and drainage applications. Some of the most common installation errors include over-tightening and the inappropriate use of female adapters.

Tapered Threads

American National Standard B2.1 is the dominant standard used for threaded fittings in piping applications. Adherence to this standard ensures that mating parts will thread properly and provide appropriate service. ANS B2.1 requires that fittings be made with tapered threads. Fittings with tapered threads work like a wedge; the wedge forming the water seal like a cork in a bottle and the threads holding the two parts together. However, this wedge also exerts tremendous force which can crack female fittings just as a small wedge tapped into a hole can be used to split giant boulders in a quarry.



In piping applications the force generated when a tapered fitting (wedge) is tightened is referred to as strain. If a threaded fitting is over-tightened, the strength of the plastic material can be exceeded, causing the material to yield and the fitting to fail.

Strain increases as the pipe diameter decreases, making it easier to split smaller-diameter threaded fittings than larger fittings. At the same time, it is easier for an installer to over-tighten small diameter fittings because less effort is required to tighten them.

Threaded Fitting Applications

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 metal male thread into a plastic female thread produces very high stress in the plastic fitting and is not recommended by Charlotte Pipe. For reasons cited above, the Uniform Plumbing Code expressly prohibits the use of CTS CPVC female adapters.

Why do metal male threads cause so much damage when threaded into plastic female threaded fittings? Why doesn't a

⚠ WARNING

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

AIR/GAS

- NEVER test with or transport/store compressed air or gas in PVC / ABS / CPVC pipe or fittings.
- NEVER test PVC / ABS / CPVC pipe or fittings with compressed air or gas, or air over water boosters.
- ONLY use PVC / ABS / CPVC pipe or fittings for water or approved chemicals.
- Refer to warnings on PPSA's website and ASTM D 1785.

NOTICE

Use of FlowGuard Gold® CTS CPVC all-plastic threaded male adapters in hot water applications may result in system failure and property damage.

- Use plastic threaded CTS CPVC male adapters in cold water applications only.
- Use CTS CPVC x brass threaded transition fittings for hot water applications.
- Do not use compression fittings with brass ferrules to connect to CTS CPVC pipe or fittings where water temperatures will exceed 140 degrees F.
- CPVC pipe can be used with standard brass ferrules to make compression connections where the operating temperature will not exceed 140°F. Apply Teflon (PTFE) tape over the ferrule to allow for the dissimilar thermal expansion and contraction characteristics of the metal ferrule and the plastic pipe.

plastic male thread cause as much of a problem? The answer is that 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, 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.

Female Adapters

An excellent example of an application where female plastic threads can be a problem is the use of Schedule 40 PVC threaded caps to test a domestic water system. In this scenario a steel pipe nipple is connected to a newly constructed domestic water



system and a PVC threaded cap is used to seal the nipple as shown in the photograph.

There are several problems with this application. First, the International and Uniform Plumbing Codes do not permit the

use of PVC 40 pipe and fittings to be used in domestic water systems within the walls of a building, so this application is not code compliant and therefore excluded under the Charlotte Pipe and Foundry limited warranty. Second, these parts are produced to conform to ASTM D 2466 for pressure piping applications, and are not designed to be part of a test apparatus for repeated and temporary installation and testing of domestic water systems. If not installed correctly and properly tightened, system or property damage could result. For this application galvanized malleable iron threaded caps would be recommended.

Do's and Don'ts For Threaded Connections

Do's

- Avoid female plastic pipe threads whenever possible.
- CPVC plastic threaded male adapters are recommended for cold water applications only.
- CPVC brass threaded transition fittings are recommended for hot and cold water applications. Brass threaded transition fittings are manufactured from low lead brass and are available in male, female and drop ear ell configurations.
- Only join to threaded components conforming to ANSI/ASME B 1.20.1 or ASTM F 1488.
- De-rate plastic threaded fittings an additional 50% beyond the pressure rating for pipe and fittings.
- Use Teflon tape for thread sealant.
- Tighten threaded connections using a strap wrench only.
- Tighten threaded connections a maximum of two turns past finger tight.
- Make threaded plastic fitting connections in conformance to ASTM F 1498

Don'ts

- Use pneumatic tools for tightening.
- Never clamp female brass threaded transition fittings in a vise.
- Never apply more than light pressure on male brass or CPVC threaded fittings when clamping in a vise.
- Never tighten threaded fittings using common wrenches or tools designed for metallic piping systems.
- Never use pipe joint compounds, pastes or lubricants to seal threaded joints.
- Never tighten threaded connections more than two turns past finger tight.
- Never use ABS, PVC or CPVC threaded caps as part of an assembly to test a domestic water system.

NOTICE

Pipe or fittings may be damaged by contact with products containing incompatible chemicals, resulting in property damage.

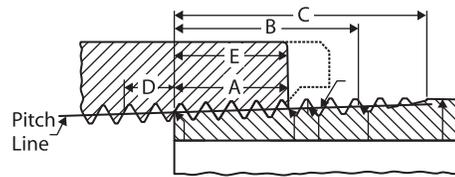
- Verify that paints, thread sealants, lubricants, plasticized PVC products, foam insulations, caulks, leak detectors, insecticides, termiticides, antifreeze solutions, pipe sleeves, firestop materials or other materials are chemically compatible with ABS, PVC, or CPVC.
- Do not use edible oils such as Crisco® for lubricant.
- Confirm compatibility of pipe marking adhesive tape with the manufacturer of the tape to ensure chemical compatibility with CPVC pipe and fittings.

Exceeding recommended torque for threaded connections may result in component damage, system failure, and property damage.

Never use thread sealant when installing a P-Trap or a Trap adapter with a plastic or metallic nut. Use of thread sealants could cause seal separation or cause damage to the fitting through over-tightening.

Maximum wrench-tightness is two turns past finger tight. Plastic or metal nuts should be tightened with a strap wrench only. Never use common wrenches or tools designed for metallic pipe systems.

Taper Thread Dimensions



*Per ANSI/ASME B1.20.1 and ASTM F 1498

PIPE		* EXTERNAL THREAD				* INTERNAL THREAD	
Nominal Size In Inches	Outside Diameter In Inches	Number of Threads Per Inch	Normal Engagement By Hand In Inches (A)	Length of Effective Thread In Inches (B)	Total Length: End of Pipe to Vanish Point In Inches (C)	Overall Thread Internal Length In Inches (D)	Number of Threads per Inch Internally (E)
¼	.540	18	.228	.4018	.5946	.500	9.00
⅜	.675	18	.240	.4078	.6006	.500	9.00
½	.840	14	.320	.5337	.7815	.640	8.96
¾	1.050	14	.339	.5457	.7935	.650	9.10
1	1.315	11½	.400	.6828	.9845	.810	9.32
1¼	1.660	11½	.420	.7068	1.0085	.850	9.78
1½	1.900	11½	.420	.7235	1.0252	.850	9.78
2	2.375	11½	.436	.7565	1.0582	.900	10.35
2½	2.875	8	.682	1.1375	1.5712	1.210	9.68
3	3.500	8	.766	1.2000	1.6337	1.300	10.40
4	4.500	8	.844	1.3000	1.7337	1.380	11.04
6	6.625	8	.958	1.5125	1.9462	1.600	12.80
8	8.625	8	1.063	1.7125	2.1462	1.780	14.24

NOTICE

Pipe or fittings may be damaged by contact with products containing incompatible chemicals, resulting in property damage.

- Verify that paints, thread sealants, lubricants, plasticized PVC products, foam insulations, caulks, leak detectors, insecticides, termiticides, antifreeze solutions, pipe sleeves, firestop materials or other materials are chemically compatible with ABS, PVC, or CPVC.
- Do not use edible oils such as Crisco® for lubricant.
- Confirm compatibility of pipe marking adhesive tape with the manufacturer of the tape to ensure chemical compatibility with CPVC pipe and fittings.

Exceeding recommended torque for threaded connections may result in component damage, system failure, and property damage.

Never use thread sealant when installing a P-Trap or a Trap adapter with a plastic or metallic nut. Use of thread sealants could cause seal separation or cause damage to the fitting through over-tightening.

Maximum wrench-tightness is two turns past finger tight. Plastic or metal nuts should be tightened with a strap wrench only. Never use common wrenches or tools designed for metallic pipe systems.

WARNING! To reduce the risk of death or serious injury, read and follow important safety, installation and application information at www.charlottepipe.com

For additional safety, installation and application information please call 800-438-6091. You may also get information 24 hours a day by calling our fax-on-demand number at 800-745-9382 or by visiting our website at www.charlottepipe.com.

Failure to follow safety and installation instructions may result in death, serious injury or property damage.

Joining Roll-Grooved Pipe

Roll-grooved PVC pipe is designed for use with conventional gasketed mechanical couplings. It offers a method of joining which is quick and convenient, and it can be used in applications where frequent assembly and disassembly are desirable.

Installation

1. Consult with the manufacturer of the couplings for recommendations on the coupling style(s) designed for use with PVC pipe and the gasket material which is suitable for the intended service.



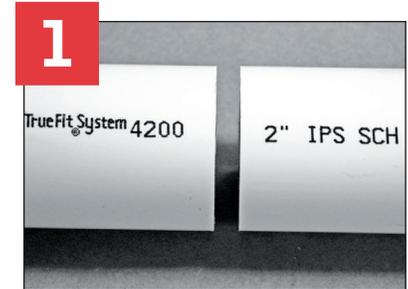
2. Check the pipe ends for any damage, roll marks, projections, or indentations on the outside surface between the groove and the end of the pipe. This is the sealing area, and it must be free of any defects.
3. Disassemble the coupling and remove the gasket. Inspect for any damage and make sure the gasket material is suitable for the intended service. Apply a thin coat of silicone lubricant to the gasket tips and the outside of the gasket.
4. Slide the gasket onto the end of one length of pipe so that it is flush with the end. Align and bring the end of another length of pipe together while sliding the gasket back over this junction. The gasket should be centered between the grooves and should not extend into the groove on either length of pipe.
5. Place the coupling housings over the gasket. The housing keys should engage into the grooves. Insert the bolts and apply the nuts. Tighten to "finger tight."

6. Using a wrench, alternately tighten the nuts to the coupling manufacturer's specifications. Over tightening is not necessary, and uneven tightening may cause gasket pinching.



Repair Coupling Installation Not for Pressure Applications

1. Cut out the segment of pipe to be replaced.



2. Remove all pipe burrs from inside and outside diameter of pipe with a knife edge, file or de-burring tool.



Chamfer (bevel) the end of the pipe 10° - 15°.



3. Position the repair coupling so that half of its length is equally divided between the two pipe ends. Mark each pipe end using the repair as a length guide.

