Installation Procedures for ABS, CPVC, and PVC Piping Systems

The following information contains 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.

ABS, CPVC, and PVC 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 ABS, CPVC, and PVC 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® CPVC CTS pipe and fitting systems with one step solvent cement.
- ½" – 4" Iron Pipe Size CPVC, and PVC pipe and fitting systems with two step solvent cement.
- ½" – 4" Iron Pipe Size Size ABS pipe and fitting systems with one step solvent cement.
- 6" Iron Pipe Size and larger CPVC, and PVC pipe and fitting systems with two step solvent cement.
- 6" Iron Pipe Size and larger larger ABS pipe and fitting systems with one 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 ABS / CPVC / PVC pipe and fitting for the conveyance of fluids as defined within the applicable ASTM standards.
- Never use ABS / CPVC / PVC pipe and fittings for the conveyance of gasses.
- Never use ABS / CPVC / PVC 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

To reduce the risk of death, serious injury, or property damage from explosion, never use with compressed air devices such as SPUD GUNS, FLAMETHROWERS, BAIT CANNONS, or COMPRESSED AIR GUNS. Always use only for fluid handling/plumbing applications.

⚠ 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.

NOTICE

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

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® CPVC CTS	½ - 2	ASTM F 493	Yellow or Green	Medium-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 recommended
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, CPVC, and PVC in iron pipe size diameters as well as for FlowGuard Gold® CPVC CTS.

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

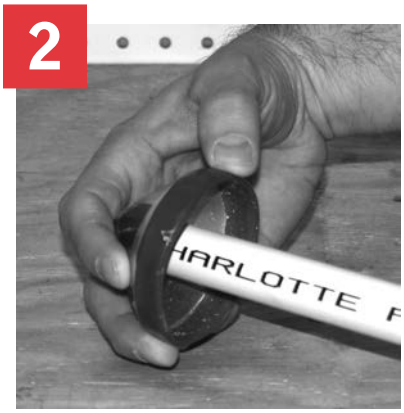
For Primer: double the number of joints shown for cement.
* These figures are estimates based on IPS Weld-on laboratory tests.
Due to many variables in the field, these figures should be used as a general guide only.

FlowGuard Gold® CPVC 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.

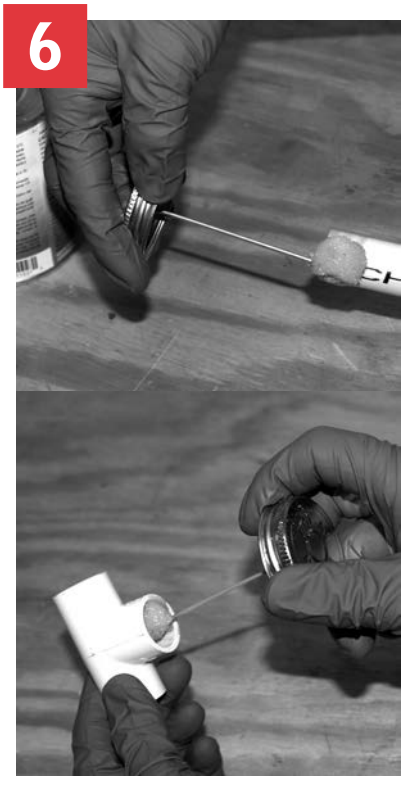
4. Dry Fit

- 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 ½" 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.

- 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, CPVC, and PVC Iron Pipe Size Installation Procedures

1/2″ – 4″ Iron Pipe Size ABS, CPVC, and PVC 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.

- Apply primer to the pipe surface to a point ½" 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 ½" 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, CPVC, and PVC Iron Pipe Size Installation Procedures

6″ and Larger Iron Pipe Size ABS, CPVC, and PVC 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

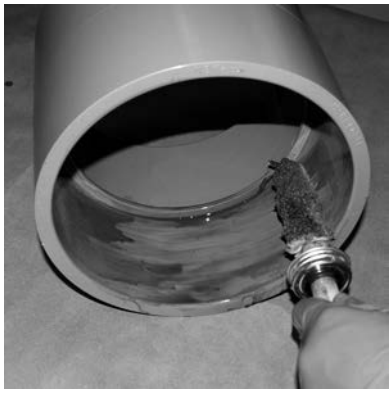
- Working rapidly, especially in adverse weather conditions, will improve installations. For 6" to 8" diameters a crew size of 2 to 3 mechanics is required. For 10" pipe diameters and larger a crew of 3 to 4 mechanics may be required.

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 ½" 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 ½" 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.

Repairs or Modifications to Existing ABS, CPVC, or PVC Systems

It is important to note that the chemical properties of all thermoplastic materials change over time. Visually, this often means that the pipe may experience color variations. In CPVC CTS applications the temperature of the water running through the pipe often determines the degree of variation, with hot water causing a more noticeable change. Exposure to ultraviolet (UV) light may also cause the exposed surface of PVC or CPVC to brown. Purple PVC, purple CPVC or ABS pipe tend to fade with UV exposure (please see **Weathering / UV Exposure** for additional information). Color variations do not indicate that the pressure carrying capabilities of the pipe have been compromised. In fact, the pressure carrying capability of thermoplastic pipe increases as the pipe ages.

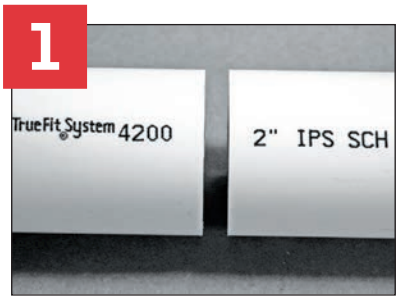
What also changes over time is the impact resistance of ABS, CPVC, and PVC piping systems, which has little effect upon installed systems. It does mean, however, that if a cut-in is necessary, additional care should be taken to prevent damaging the existing system. This is typically a greater issue with thin-wall, smaller-diameter piping systems such as CTS CPVC, PVC PR 200, PVC PR 160 or Schedule 40 PVC. Ratchet cutters or compression connections may compress the pipe and cause end cracks on aged pipe. Even if the cracks are not visible, they can eventually propagate through the fitting and cause a leak.

Charlotte Pipe recommends using a fine-tooth saw when performing cut-in operations. Once the pipe is cut, continue with standard installation procedures. Keep in mind that if the area is wet, additional cure time is required and may be three times as long. The inside and outside diameter of pipe and fittings should be kept as dry as possible.

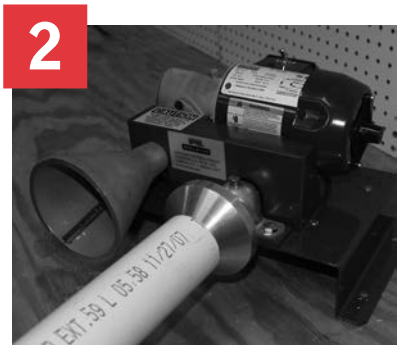
Repair Coupling Installation

Not for Pressure Applications

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

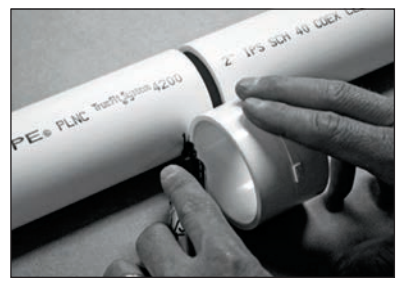


2. Remove all pipe burrs from inside and outside diameter of pipe with a knife edge, file or de-burring tool.



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.



4. Place the repair coupling on the pipe with the larger pipe ID (inside diameter) end facing the gap between the pipe ends.

5. Apply primer between the mark and pipe end on both pipe ends.
Note: The use of primer for ABS is not recommended. Check local code requirements.

6. Apply heavy body cement (if using PVC) and apply medium body cement (if using ABS) between the mark and pipe end on both pipe ends.

7. Push the repair coupling toward the gap until you reach the mark on the other pipe end. A bead of cement will be present around the entire diameter of the pipe and coupling.

ConnecTite Installation Procedures

1-1/2"- 3" Iron Pipe Size Pipe and Fitting Systems

1. Cut Pipe

- Cut pipe square with the axis. 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 Sand

- Remove all pipe burrs from inside and outside diameter of pipe with a knife edge, file or de-burring tool.
- Sand outside corner of pipe around entire diameter using sanding sponge for a minimum of 20 seconds.

3. Clean and Dry Pipe

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

4. Mark

- Mark pipe with a minimum insertion line. This is determined by pipe diameter.

Pipe Size	Mark
1½"	¾"
2"	1"
3"	1¼"

5. Lubricate

- Apply a silicone based lubricant or liquid dish soap to both the pipe and the gasket.

6. Initial Insert and Alignment

- Gently insert pipe into fitting hub until you feel resistance from the rubber gasket.
- Stop and check to ensure pipe is properly aligned with fitting hub.

- NOTE: Misalignment can cause damage

7. Fully Insert, Twist, and Align

- Fully insert pipe into fitting hub, applying steady force and twist pipe and/or fitting until the minimum insertion mark is no longer visible and you cannot insert pipe any further.

- Align by twisting the fitting to desired alignment; check to ensure pipe is fully inserted

- To disconnect, simultaneously twist and pull pipe and/or fitting until pipe is removed from the ConnecTite fitting
  - o Check to ensure rubber gasket and metal lock ring are not damaged or out of place

- Reuse a maximum of three times
- Use clean pipe end; scratches on pipe can cause leaks

Installation of FlowGuard Gold CPVC CTS Threaded Fittings

1. Make sure threads are clean.
2. Use Teflon tape thread sealant on Brass and CPVC threaded connections. Use a good quality Teflon tape which has .4 minimum density, .003" thick, .50% elongation and chemically inert. 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. Follow the chart below for the correct amount of tape and torque required to make a properly functioning assembly.

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

⚠ WARNING

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

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

NOTICE

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

- Use plastic threaded CPVC CTS male adapters in cold water applications only.
- Use CPVC CTS x brass threaded transition fittings for hot water applications.
- Do not use compression fittings with brass ferrules to connect to CPVC CTS 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.

Installation of ABS, CPVC, and PVC Threaded Connections without O-rings

Diameters 1 inch or Smaller

1. Make sure the threads are clean.
2. Charlotte Pipe recommends Teflon® tape thread sealant for threaded connections 1-inch or smaller. Use a good quality Teflon tape which has .4 minimum density, .003" thick, .50% elongation and chemically inert. 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. Tighten with a strap wrench or similar tool. Do not use common wrenches or tools designed for metallic pipe systems.

NOTICE

All pipe thread sealants must conform to the requirements of IAPMO's PS 36 and with the thread sealant manufacturer to confirm that these sealants are chemically compatible with ABS, CPVC, and PVC. Incompatible pipe thread sealants may result in the degradation of plastic pipe or fittings resulting in product failure and 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, CPVC, or PVC.
- 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.

Diameters 1-1/4 inch or Larger

1. Make sure the threads are clean.
2. Charlotte Pipe recommends paste type non-hardening thread sealant for threaded connections 1-1/4 inch or larger. All thread sealants must conform to the requirements of IAPMO PS 36 and NSF Standard 61. Chemical compatibility of joint compounds and thread sealants with ABS, CPVC, and PVC should be verified with the thread sealant manufacturer.
3. Maximum wrench-tightness is two turns past finger tight. Tighten with a strap wrench or similar tool. Do not use common wrenches or tools designed for metallic pipe systems.

NOTICE: All pipe thread sealants must conform to the requirements of IAPMO PS 36 and with the thread sealant manufacturer to confirm that these sealants are chemically compatible with ABS, CPVC, and PVC. Incompatible pipe thread sealants may result in the degradation of plastic pipe or fittings resulting in product failure and property damage.

NOTICE

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

Installation of threaded Connections with O-ring Plugs

NOTICE: To reduce the risk of property damage from leakage, never use thread sealants, pastes, tapes or lubricants with fittings and/or plugs supplied with an O-ring. They may contain chemicals that damage the O-ring.

1. These procedures only apply to plugs supplied with an O-ring.
2. Using a clean cloth, make sure the threads of the mating part, the plug threads, all sealing surfaces and the O-ring are clean.
3. Tighten plug until finger tight. At this point, a gap between the O-ring and the top edge of the sealing surface should not be present.
4. Maximum wrench-tightness is ½ turn past finger tight. Tighten with a strap wrench or similar tool. Do not use common wrenches or tools designed for metallic pipe systems.

⚠ WARNING

Pipe or fittings may be damaged by contact with products containing incompatible chemicals resulting in personal injury or 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, CPVC, and PVC.
- Do not use edible oils such as Crisco® for lubricant.
- Read and follow chemical manufacturer's literature before using with piping materials.

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/nut. The ring/nut should not draw piping systems together or correct improper alignment of the system. The ring/nut 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.

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 ring/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.

⚠ WARNING

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

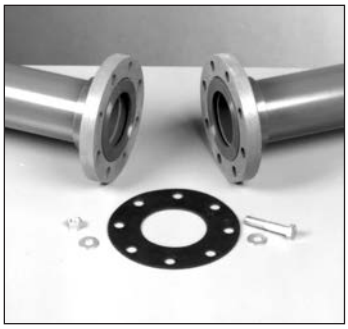
- NEVER test with or transport/store compressed air or gas in ABS / CPVC / PVC pipe or fittings.
- NEVER test ABS / CPVC / PVC pipe or fittings with compressed air or gas, or air over water boosters.
- ONLY use ABS / CPVC / PVC pipe or fittings for water or approved chemicals.
- Refer to warnings on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

For information on the pressure ratings of PVC and CPVC schedule 80 unions please refer to the pressure rating of fittings, flanges, and union sections in the design and engineering section of this manual.

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.

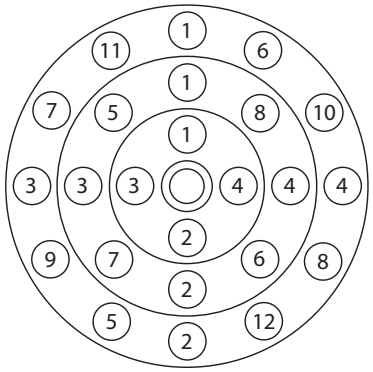
NOTE: Charlotte Pipe Flanges are shipped with a QR code sticker that directs installers to the installation information below.



Installation

1. 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.
2. Use a full faced elastomeric gasket which is resistant to the chemicals being conveyed in the piping system. A gasket ⅛" thick with a Durometer, scale "A", hardness of 55 -80 is normally satisfactory.
3. 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.
4. 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.
5. 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.

Flange Tightening Sequence



6. Use a torque wrench to tighten the bolts to the torque values shown below.
7. Use of thread lubricant will ensure proper torque. Confirm that the thread lubricant is chemically compatible with pipe and fittings.

8. 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
½	4	½	10 - 15
¾	4	½	10 - 15
1	4	½	10 - 15
1¼	4	½	10 - 15
1½	4	½	10 - 15
2	4	⅝	20 - 30
2½	4	⅝	20 - 30
3	4	⅝	20 - 30
4	8	⅝	20 - 30
6	8	¾	33 - 50
8	8	¾	33 - 50
10	12	⅞	53 - 65
12	12	⅞	53 - 75

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

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.

For information on the pressure ratings of PVC and CPVC flanges please refer to the pressure rating of fittings, flanges, and union sections in the design and engineering section of this manual.

Threading of CPVC and PVC Schedule 80 Pipe 1/2" - 4"

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 CPVC and PVC, 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 ±1½ turns.

NOTE: Charlotte Pipe does not recommend threading any other thermoplastic pipe other than CPVC and PVC Schedule 80.

Mechanical Grooved Couplings

Grooved CPVC and 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. Charlotte Pipe recommends that inquiries about the suitability of plastic piping systems used with mechanical grooved couplings be directed to the manufacturer of the mechanical grooved couplings.

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

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.

NOTICE

All pipe thread sealants must conform to the requirements of IAPMO's PS 36 and with the thread sealant manufacturer to confirm that these sealants are chemically compatible with ABS, PVC, and CPVC. Incompatible pipe thread sealants may result in the degradation of plastic pipe or fittings resulting in product failure and 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.

⚠ WARNING

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

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

Gasketed Pipe Assembly*

Bar and block is the recommended method of assembly. Small-diameter pipes can be assembled by one worker, while larger diameters may require two people working together.

Besides quicker installation of a pipe line, the major advantage of barring pipe (see Bar & Block illustration below) is that the worker has a feel for the process. This assures proper alignment and assembly.

NOTE: Assembly with power equipment is not recommended.

Standard good mechanical assembly practice take alignment into consideration and produces reliable, leak-free pipe lines.

Straight alignment assembly will not dislodge gaskets. Forced, improper alignment insertion produces an insertion curve characterized by the tremendous force necessary to dislodge the gasket from the race, trap it between the bell and spigot surfaces, and stretch it backwards. The insertion force necessary to assemble a joint with dislodged gaskets is so extreme, it can only be accomplished using mechanical equipment without the operator's knowledge of the dislocation.

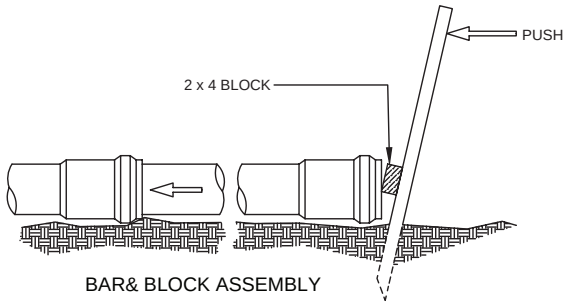
Joint Insertion Instructions

1. Clean the gasket area. Remove sand, dirt, grease, and debris. Do not remove gaskets from bells.
2. Check the gasket. Make sure it is seated uniformly in the groove by running your finger around the inner edge of the gasket. If the gasket has a plastic retainer ring, make sure it it's properly seated into the rubber portion of the gasket.
3. Clean the spigot. Use a rag to wipe the spigot clean.
4. Lower the pipe into the trench carefully to avoid getting dirt onto the bell or spigot.
5. Lubricate. Apply approved pipe lubricant to the bevel of the spigot end and approximately mid-way back to the reference line. A thin layer of lubricant may be applied to the face of the gasket, but be careful not to get lubricant behind or under the gasket.
6. Keep lubricated areas clean. If dirt or sand adheres to lubricated areas, clean and re-lubricate.

7. Assemble pipe. Insert the spigot end into the pipe until it contacts the gasket uniformly or is a short distance from the gasket. Straight alignment is essential. Apply steady pressure by hand or by mechanical means (bar and block, come-along, hydraulic jack) until the spigot slips through the gasket. Insert pipe until the assembly stop line is flush with the bell end.

8. If undue resistance to pipe insertion is encountered or if the pipe cannot be inserted to the reference mark, disassemble the joint and check the position of the gasket. If the gasket is still properly positioned, verify proper positioning of the reference mark. Relocate the mark if it is not correctly positioned. In general, fittings allow less insertion than do pipe bells.

9. If the pipe must be field-cut, mark the entire circumference to ensure a square cut. Bevel the field cut the same as a factory bevel. If being installed into fittings, follow manufacturer's recommendations. Round off any sharp edges on the leading edge of the bevel with a pocket knife or a file. Mark cut end with an insertion line similar to uncut pipe.



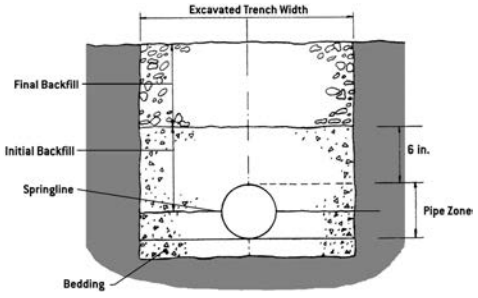
*Data and language courtesy of Hultec

Underground Installation of Plastic Pipe

Plastic pipe should always be buried in strict accordance with the ASTM standard relevant to the type of plastic piping system being installed. Those standards are:

ASTM D2321	Standard practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications
ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM F1668	Standard Guide for Construction Procedures for Buried Plastic Pipe

Note: In addition to these standards, pipe should always be installed in accordance with all local code requirements.



Recommendations for underground installation of plastic drainage pipe:

1. The minimum width of the trench should be the pipe OD (outside diameter) plus 16 inches, or the pipe outside diameter times 1.25 plus 12 inches. This will allow adequate room for joining the pipe, snaking the pipe in the trench to allow for expansion and contraction where appropriate, and space for backfilling and compaction of backfill. The space between the pipe and trench wall must be wider than the compaction equipment used to compact the backfill.

2. Provide a minimum of 4 inches of firm, stable and uniform bedding material in the trench bottom. If rock or unyielding material is encountered, a minimum of 6 inches of bedding shall be used. Blocking should not be used to change pipe grade or to intermittently support pipe over low sections in the trench.

3. The pipe should be surrounded with an aggregate material which can be easily worked around the sides of the pipe. Backfilling should be performed in layers of 6 inches with each layer being sufficiently compacted to 85% to 95% compaction.

4. A mechanical tamper is recommended for compacting sand and gravel. These materials contain fine-grains such as silt and clay. If a tamper is not available, compacting should be done by hand.

5. The trench should be completely filled. The backfill should be placed and spread in uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, frozen clods, or other large debris should be removed. Stone backfill shall pass through an 1-1/2" sieve. Heavy tampers or rolling equipment should only be used to consolidate the final backfill.

6. To prevent damage to the pipe and disturbance to pipe embedment, a minimum depth of backfill above the pipe should be maintained. Pipe should always be installed below the frost level. Typically, it is not advisable to allow vehicular traffic or heavy construction equipment to traverse the pipe trench.

Note: This section is a general reference guide and should not be considered a complete engineering resource addressing all aspects of design and installation of pipe in buried applications. Charlotte Pipe recommends that a design professional use this manual along with other industry references, taking into account sub-surface conditions unique to each project, and that all installations be made in accordance with the requirements found in ASTM D 2321 and in compliance with applicable code requirements.

Unstable Soil

Burial of pipe under slab in soils that are unstable is often accomplished by suspending the piping systems from structural slabs. The use of plastic pipe in such installations must be in accordance with ASTM F 2536. Cellular core pipe is specifically not permitted for these applications.

When unstable soil requires the drain and waste line to be supported with hangers attached to the concrete slab, sway bracing should always be a part of the support system. Sway bracing will help keep the system in proper alignment and help eliminate movement from side to side.

CPVC Under-Slab Installations

CPVC is suitable for under-slab installations when approved by prevailing plumbing and building codes.

When performing under-slab installations, it is important that the pipe be evenly supported. Charlotte Pipe recommends pressure testing with water prior to backfilling and pouring the slab. Backfill should be clean earth, sand, gravel or other approved material, which must not contain stones, boulders or other materials that may damage or break the piping. The pipe should be protected from damage by tools and equipment used to finish the concrete. Because CPVC does not react to concrete or stucco and is inert to acidic soil conditions, it does not need to be sleeved. **NOTE:** Some code jurisdictions require sleeving at slab penetrations. Verify code requirements prior to installation.

Do not bend FlowGuard Gold® 1/2" and 3/4" pipe in a radius tighter than 18"; 1" pipe should not be bent in a radius tighter than 24".

Check applicable plumbing and building codes before making under-slab installations.

In-Slab Installations

CPVC is not suitable for in-slab radiant heating systems.

ABS, CPVC, and PVC piping can be installed embedded in a concrete slab, because ABS, CPVC, and PVC do not react to concrete or stucco and it is inert to acidic soil conditions. Care must be taken to properly support any piping system when pouring concrete so that the weight of the concrete does not affect the pipe system and that any heat generated by curing concrete does not exceed the capability of the system.

Some codes require sleeving or protection of piping at slab penetrations. While not necessary due to any corrosion issues, always follow applicable code requirements on any installation.

Testing and Inspection

⚠ WARNING

In any test, proper safety procedures and equipment should be used, including personal protective equipment such as protective eyewear and clothing. Installers should always consider local conditions, codes and regulations, manufacturer's installation instructions, and architects'/engineers' specifications in any installation.

Once the roughing-in is completed on a plastic piping system, it is important to test and inspect all piping for leaks. Concealed work should remain uncovered until the required test is made and approved. When testing, the system should be properly restrained at all bends, changes of direction, and the end of runs.

There are various types of procedures used for testing installed plastic systems. However, a water or hydrostatic test is a technically superior test method for inspecting a completed plastic piping system installation and is the testing procedure recommended by Charlotte Pipe. It is also the most recommended test in most plumbing code standards. The purpose of the test is to locate any leaks at the joints and correct them prior to putting the system into operation. Since it is important to be able to visually inspect the joints, a water test should be conducted prior to closing in the piping or backfilling of underground piping.

Testing DWV System

Water Test

The system should be properly restrained at all bends, changes of direction, and the end of runs. To isolate each floor or section being tested, test plugs are inserted through test tees in the stack. All other openings should be plugged The system should be properly restrained at all bends, changes of direction, and the end of runs. To isolate each floor or section being tested, test plugs are inserted through test tees in the stack. All other openings should be plugged or capped with test plugs or test caps.

When testing Foam Core pipe, always use external caps to eliminate the possibility of leakage through the foam core layer of the pipe.

Fill the system to be tested with water at the highest point. As water fills a vertical pipe it creates hydrostatic pressure. The pressure increases as the height of the water in the vertical pipe increases. Charlotte Pipe recommends testing at 10 feet of hydrostatic pressure (4.3 pounds per square inch.) Filling the system slowly should allow any air in the system to escape as the water rises in the vertical pipe. All entrapped air in the system should be expelled prior to the beginning of the test. Failure to remove entrapped air may give faulty test results.

Once the stack is filled to "ten feet of head," a visual inspection of the section being tested should be made to check for leaks. If a leak is found, the joint must be cut out and a new section installed. Once the system has been successfully tested, it should be drained and the next section prepared for testing.

⚠ WARNING

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

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

Alternate Test Methods

Vacuum Test

Charlotte Pipe and Foundry recognizes vacuum testing of ABS and PVC DWV piping system to 8.75 inches of mercury is a safe practice and does not object to conducting this type of test. However, vacuum testing is complex and requires dedicated equipment. Identifying leak sites can be difficult. The plumbing industry has not developed an efficient methodology for vacuum testing piping systems in the field.

The Smoke Test

⚠ WARNING

To reduce the risk of fire, smoke inhalation, chemical inhalation or burns, never use chemical mixtures for producing smoke. These mixtures may be dangerous and can cause serious personal injury.

Should a smoke test be specified by an engineer, architect, or plumbing code, proceed as follows:

1. Permanently connect all fixtures and fill all traps with water.
2. Be prepared to test all parts of the plumbing drainage and ventilation system.
3. Close all windows in the building until the test has been completed.
4. Fill the system with a thick, penetrating smoke that has been generated by one or more smoke-producing machines.
5. When smoke begins to appear at the stack opening on the roof, close off that opening.
6. Continue filling the system with smoke until a pressure equal to one inch of water is built up.
7. Maintain this pressure for fifteen minutes or longer, as required to test the entire system.
8. Check all components of the system to help ensure that smoke is not escaping. Smoke should not be visible at any point, connection, or fixture.

The Peppermint Test

This test is most often used in older installations to detect faulty plumbing. **NOTE:** Peppermint oils are not chemically compatible with ABS and therefore should not be used to test ABS DWV systems. The peppermint test should only be used to test PVC DWV systems.

1. Permanently connect all fixtures and fill all traps with water.
2. Be prepared to test all parts of the plumbing drainage and ventilation system.
3. Close all windows in the building until the test has been completed.
4. Mix two ounces of peppermint oil with one gallon of hot water.
5. Pour the mixture into the system's roof opening.
6. Tightly close the roof opening.
7. Have a person other than the one that poured the mixture into the system inspect the system for any odor of peppermint.
8. Inspect all system points, connections, and fixtures. There should be no odor of peppermint within the building.

Testing Pressure System

1. Prior to testing, safety precautions should be instituted to protect personnel and property in case of test failure.
2. Conduct pressure testing with water.
3. The piping system should be adequately anchored to limit movement. Water under pressure exerts thrust forces in piping systems. Thrust blocking should be provided at changes of direction, change in size and at dead ends.
4. The piping system should be slowly filled with water, taking care to prevent surge and air entrapment. The flow velocity should not exceed 5-feet per second for CPVC Schedule 80 and PVC, and 8-feet per second for CPVC CTS (see Friction Loss and Flow Velocity charts in this manual).

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.

⚠ WARNING

Entrapped Air

- **Pressure surges associated with entrapped air may result in serious personal injury, system failure, and property damage.**
- Install air relief valves at the high points in a system to vent air that accumulates during service.
- Failure to bleed trapped air may give faulty test results and may result in an explosion.