Connection Options

The ChemDrain® System offers several options for joining CPVC pipe and fittings and joining CPVC to a wide variety of alternative materials. All of the approved options available for use in a ChemDrain system are outlined here, including solvent welding, flanged connections and ChemDrain chemical couplings.

⚠ WARNING

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.

The Exclusive Charlotte Pipe® System

Charlotte® CPVC pipe, fittings, bushings, and tees are made to exacting tolerances, meaning everything is designed to fit together properly. Using our products, you'll work more efficiently and productively, with fewer callbacks.

Advantages of Solvent Welding

One major advantage of CPVC for chemical waste disposal applications is its use of chemically welded joints. Solvent welding is a simple, consistent and reliable method of creating joints that requires no special tools or costly fusion equipment. ChemDrain CPVC Cement is specifically formulated for chemical waste applications. The resulting joints are as strong and durable as the pipe itself, with the same chemical resistance and physical properties as the pipe and fittings.

This is in sharp contrast to mechanical connectors or heat-fusion methods, which often burn through or are left exposed to the flow of corrosive chemicals, which may cause a leak path to develop over time.

Although the material used to create solvent welds commonly is referred to as "cement," it has none of the properties of cement. It is neither glue nor an adhesive. Instead the process commonly known as "solvent welding" chemically fuses the pipe and the fitting material by temporarily softening the two pieces to create semi-fluid surfaces. Wedging the treated pipe into a softened, tapered fitting socket forces the two semi-fluid surfaces together and allows them to chemically fuse as the CPVC re-hardens. As the solvent evaporates, or cures, the final fused joint is created. To avoid confusion, Charlotte Pipe refers to this process exclusively as "solvent welding."

Charlotte Pipe recommends only Charlotte Pipe and Foundry **ChemDrain CPVC Cement** for use in ChemDrain applications. **ChemDrain CPVC Cement** is specially formulated for chemical resistance to caustics including hypochlorites, mineral acids and other corrosive chemicals. The other joining options for the ChemDrain system are described in the following installation procedures.

Installation Procedures for ChemDrain® CPVC Systems

⚠ 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.

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- 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.

Basic Principles of Solvent Welding

To make consistently good joints the following should be clearly understood:

1. The joining surfaces must be softened and made semi-fluid.
2. Sufficient cement must be applied to fill the gap between pipe and fitting.
3. Assembly of pipe and fittings must be made while the surfaces are still wet and fluid.
4. Joint strength develops as the cement dries. In the tight part of the joint the surfaces will fuse together, in the loose part the cement will bond to both surfaces.

NOTICE

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

Solvent Cements

⚠ 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. **Primers and cements are extremely flammable and may be explosive. Do not store or use near heat or open flame, or death or serious injury may occur.**

- 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.

ChemDrain chemical waste systems must be joined with ChemDrain one-step solvent cement conforming to ASTM F 493.

Charlotte ChemDrain solvent cement is classified as "Low-VOC" (volatile organic compounds) per the emission limits established by the California South Coast Air Quality Management District (SCAQMD). Material Safety Data Sheets (MSDS) for Charlotte ChemDrain solvent cement are available for download at www.charlottepipe.com.

Solvent cements are formulated to be used "as received" in original containers. Adding of thinners to change viscosity is not recommended. If the cement is found to be jelly-like and is not free-flowing, it should not be used. Containers should be kept covered when not in actual use.

Solvent cements should be stored at temperatures between 40° F and 110° F and away from heat or open flame. The cements should be used within two years of the date stamped on the container. Stocks should be constantly rotated to prevent build-up of old cement inventories. If new cement is subjected to freezing, it may become extremely thick or gelled. This cement can be placed in a warm area where, after a period of time, it will return to its original, usable condition. However, this is not the case when the cement has gelled due to actual solvent loss; for example, when the container was left open too long during use or not sealed properly after use. Cement in this condition has lost its formulation and should be discarded.

Solvent cements are extremely flammable and should not be used or stored near heat or open flame. They should be

used only with adequate ventilation. In confined or partially enclosed areas, a ventilating device should be used to remove vapors and minimize their inhalation. Containers should be kept tightly closed when not in use and covered as much as possible when in use. Avoid frequent contact with the skin. In case of eye contact, flush repeatedly with water. Keep out of reach of children.

Making the Joint

1. Cut Pipe

- Cut the 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 miter saw, reciprocation saw, and mechanical cut-off saw with carbide-tipped blade or wheel-type pipe cutter.
- If any indication of damage or cracking is evident at the pipe end, cut off at least 2" 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.
- If the wiping fails to clean the surfaces, use a compatible cleaner.

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 cement into the inside of the fitting. Too small an applicator will not apply sufficient cement.

⚠ 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. **Primers and cements are extremely flammable and may be explosive. Do not store or use near heat or open flame, or death or serious injury may occur.**

- 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.

6. Apply Solvent Cement and Primer

NOTE: The ChemDrain one-step cement procedure does not normally require the use of a primer on clean, dry pipe and fittings in sizes 1 ½" to 4". On 6" and 8" sizes or in wet, very cold (40°F or less), or very hot (90°F and higher) conditions the use of a quality high-strength primer such as IPS Weld-on P70, Oatey "Industrial Grade" or equal is recommended to ensure a well-bonded joint.

If using a primer:

- Apply primer to the fitting socket by 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.
- Once the surface is primed remove all puddles of excess primer from the fitting socket.

Apply 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 of the pipe.

- 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. All-purpose cement or cement not clearly marked as intended for CPVC Chemical Waste Systems is not recommended.

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.
- While inserting pipe into fitting hub give the pipe a quarter turn which helps ensure 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.
- See table on following page 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.
- For pipe sizes 6" and larger, two people will be required, a mechanical forcing device should be used and the joint should be held together for up to 3 minutes.

Applicators

To properly apply the cement, the correct size and type of applicator must be used. There are three basic types of applicators:

Daubers — should only be used on pipe sizes 2" and below, and should have a width equal to 1/2 the diameter of the pipe.

Brushes — can be used on any diameter pipe, should always have natural bristles, and should have a width equal to at least 1/2 the diameter of the pipe.

Swabs — can be used on 4" and larger diameter pipe and should have a length equal to at least 1/2 the diameter of the pipe.

Applicator Type

Nominal Pipe Size (in.)	Applicator Type		
	Dauber	Brush Width (in.)	Swab Length (in.)
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
5	NR	3 - 5	3
6	NR	3 - 5	3
8	NR	4-6	7

A = Acceptable NR = Not Recommended

Joint Curing

The joint should not be disturbed until it has initially set. **CAUTION:** Do not test the system until the solvent cement joints have fully cured. Follow the recommendations in Testing a ChemDrain CPVC System on page 36 of this technical manual. The exact curing time varies with temperature, humidity and pipe size. The following chart shows recommended set and cure times.

Recommended Set and Cure Time

Temperature	Initial Set	Cure
60° - 100° F	30 min.	1 hr.
40° - 60° F	1 hr.	2 hrs.
0° - 40° F	2 hrs.	4 hrs.

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

Average Number of Joints Per Quart of Solvent Cement

Pipe Diameter (in.)	Number of Joints
1½	90
2	60
3	40
4	30
6	10
8	5

The above data are based on laboratory tests and are intended as guidelines. For more specific information, consult the cement manufacturer.

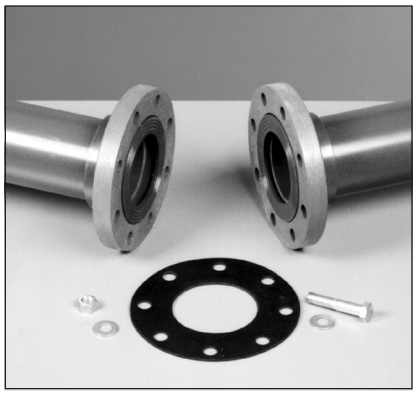
NOTICE

- 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.

Flanging CPVC Pipe

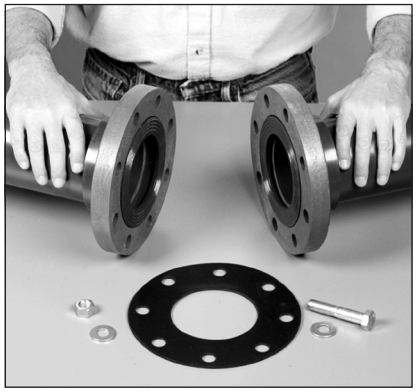
For systems where dismantling is required, flanging is a convenient joining method. It is also an easy way to join plastic and metallic systems.

Installation



1. Join the flange to the pipe using the procedures shown in the solvent cementing section (pages 29-31).

2. Use a full faced elastomeric gasket which is resistant to the chemicals being conveyed in the piping system. A gasket 1/8" 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 corresponding to the following patterns shown.

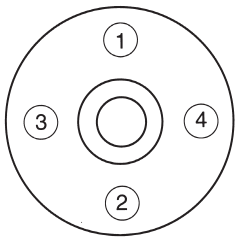
5. Use a torque wrench to tighten the bolts to the torque values shown in the following chart.

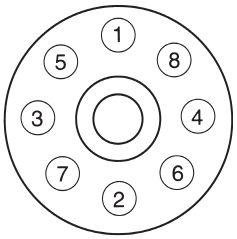
Recommended Torque

Pipe Size In Inches	No. Bolt Holes	Bolt Diameter	Recommended Torque ft/lbs
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

Note: Flanges meet the bolt-pattern requirements of ANSI / ASME B 16.5
1 foot pound = 12 inch pounds

Flange Bolt Tightening Sequence





Connecting CPVC to Other Materials

Occasionally, it is necessary to connect ChemDrain® CPVC piping systems to piping systems made of other materials, including steel, cast iron, Durion®, glass and other types of plastic. In these cases, Charlotte Pipe recommends the use of ChemDrain Chemical Couplings (known generically as "hubless joints").

ChemDrain Chemical Couplings are designed to provide flexible, water-tight joints on chemical drainage systems. They consist of a high-performance fluoroelastomer sleeve, an outer stainless steel shear ring and two AISI 301 stainless steel clamping bands. The fluoroelastomer gasket is resistant to most chemicals and solvents and features a low compression set and stress relaxation properties that helps to ensure sealing performance and longevity. Fluoroelastomer gaskets have a broad thermal range and provide excellent resistance to atmospheric oxidation, weathering, sunlight and ozone.

NOTICE

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

Making Joints with ChemDrain Chemical Couplings

1. Place the Fluoroelastomer sleeve on the end of the pipe or fitting, firmly seating the pipe or fitting end against the integrally molded shoulder inside the sleeve. Next, place the stainless-steel shield on the other component you're joining.
2. Insert the other component you're joining into the other side of the Fluoroelastomer sealing sleeve, firmly seating the pipe or fitting end against the integrally-molded shoulder inside the sleeve.
3. Slide the clamp assembly into position over the Fluoroelastomer sleeve, and use the following procedures to tighten the bands to 60 inch-pounds, using a properly calibrated torque wrench.
   - For sizes 1½" through 6", coupling has two bands. Take the slack out of the clamp alternately and firmly, then tighten in the same sequence with a preset torque wrench to 60 inch-pounds.

Installation of Threaded Connections

1. Make sure the threads are clean.
2. Charlotte Pipe recommends paste-type, non-hardening thread sealant for threaded connections 1¼ 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 PVC, ABS and CPVC 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 CPVC. Incompatible pipe thread sealants may result in the degradation of plastic pipe or fittings resulting in product failure and property damage.

⚠ WARNING

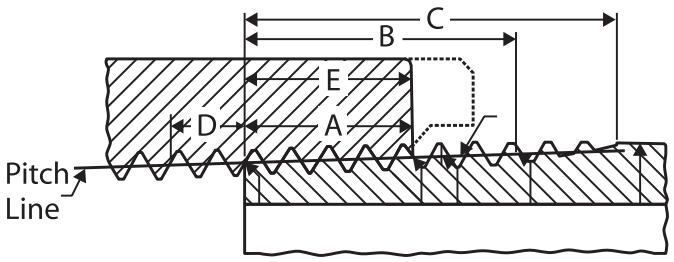
Pipe or fittings may be damaged by contact with products containing incompatible chemicals resulting in personal injury or property damage.

- 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.

NOTICE

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

External Taper Thread Dimensions



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

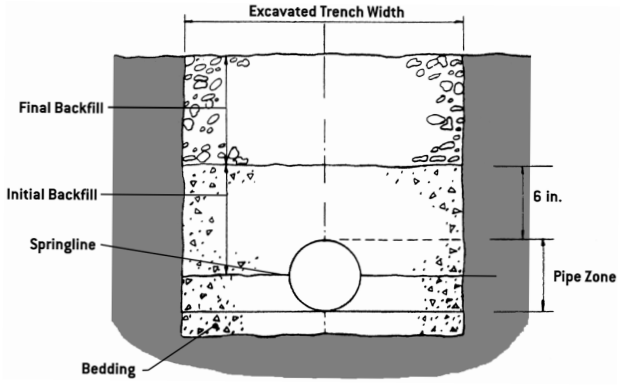
PIPE		* EXTERNAL THREAD				* INTERNAL THREAD	
Nominal Size In Inches	Outside Diameter In Inches	Number of Threads Per Inch	Normal Engagement By Hand In Inches (A)	Length of Effective Thread In Inches (B)	Total Length: End of Pipe to Vanish Point In Inches (C)	Overall Thread Internal Length In Inches (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

Underground Installation

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.

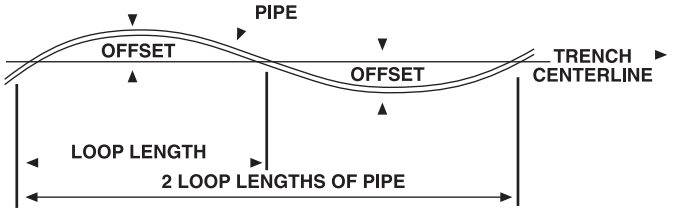


Recommendations for underground installation of plastic drainage pipe:

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 1½" sieve. Rock size should be about 1/10th of the pipe outside diameter. 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.

	Max. Temp. Variation ° F, Between Installation and Final Operation									
	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Loop Length In Feet	Loop Offset In Inches									
20	3.0	3.5	4.5	5.0	6.0	6.5	7.0	7.0	8.0	8.0
50	7.0	9.0	11.0	13.0	14.0	15.5	17.0	18.0	19.0	20.0
100	13.0	18.0	22.0	26.0	29.0	31.5	35.0	37.0	40.0	42.0



Note: This manual is not a complete engineering reference addressing all aspects of design and installation of thermal expansion in piping systems. Many excellent references are available on this topic. The American Society of Plumbing Engineers (www.ASPE.org) Data Book, Volume 4, 2008 Chapter 11 is an excellent resource for engineers on designing for thermal expansion.